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Phylogeny, identification and nomenclature of the genus *Aspergillus*

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Abstract: *Aspergillus* comprises a diverse group of species based on morphological, physiological and phylogenetic characters, which significantly impact biotechnology, food production, indoor environments and human health. *Aspergillus* was traditionally associated with nine teleomorph genera, but phylogenetic data suggest that together with genera such as *Polypaecilum*, *Phialosimplex*, *Dichotomomyces* and *Cristaspora*, *Aspergillus* forms a monophyletic clade closely related to *Penicillium*. Changes in the International Code of Nomenclature for algae, fungi and plants resulted in the move to one name per species, meaning that a decision had to be made whether to keep *Aspergillus* as one big genus or to split it into several smaller genera. The International Commission of *Penicillium* and *Aspergillus* decided to keep *Aspergillus* instead of using smaller genera. In this paper, we present the arguments for this decision. We introduce new combinations for accepted species presently lacking an *Aspergillus* name and provide an updated accepted species list for the genus, now containing 339 species. To add to the scientific value of the list, we include information about living ex-type culture collection numbers and GenBank accession numbers for available representative ITS, calmodulin, β -tubulin and *RPB2* sequences. In addition, we recommend a standard working technique for *Aspergillus* and propose calmodulin as a secondary identification marker.

Key words: Fungal identification, Phylogeny, Media, Nomenclature.

Taxonomic novelties: New names: *Aspergillus baarnensis* Samson, Visagie & Houbraken, *Aspergillus chinensis* Samson, Visagie & Houbraken, *Aspergillus delacroixii* Samson, Visagie & Houbraken, *Aspergillus jaipurensis* Samson, Visagie & Houbraken, *Aspergillus solicola* Samson, Visagie & Houbraken; **New combinations:** *Aspergillus arxii* (Fort & Guarro) Houbraken, Visagie & Samson, *Aspergillus assulatus* (S.B. Hong, Frisvad & Samson) Houbraken, Visagie & Samson, *Aspergillus astellatus* (Fennell & Raper) Houbraken, Visagie & Samson, *Aspergillus australensis* (Samson, S.B. Hong & Varga) Houbraken, Visagie & Samson, *Aspergillus caninus* (Sigler, Deanna A. Sutton, Gibas, Summerb. & Iwen) Houbraken, Tanney, Visagie & Samson, *Aspergillus capsici* (J.F.H. Beyma) Houbraken, Visagie & Samson, *Aspergillus cejpaii* (Milko) Samson, Varga, Visagie & Houbraken, *Aspergillus chlamydosporus* (Gené & Guarro) Houbraken, Tanney, Visagie & Samson, *Aspergillus denticulatus* (Samson, S.B. Hong & Frisvad) Samson, S.B. Hong, Visagie & Houbraken, *Aspergillus desertorum* (Samson & Mouch.) Samson, Visagie & Houbraken, *Aspergillus ferenczii* (Varga & Samson) Samson, Varga, Visagie & Houbraken, *Aspergillus galapagensis* (Frisvad, S.B. Hong & Samson) Samson, Frisvad & Houbraken, *Aspergillus inflatus* (Stolk & Malla) Samson, Frisvad, Varga, Visagie & Houbraken, *Aspergillus insolitus* (G. Sm.) Houbraken, Visagie & Samson, *Aspergillus papuensis* (Samson, S.B. Hong & Varga) Samson, S.B. Hong & Varga, *Aspergillus pisci* (A.D. Hocking & Pitt) Houbraken, Visagie & Samson, *Aspergillus pluriseminatus* (Stchigel & Guarro) Samson, Visagie & Houbraken, *Aspergillus sclerotialis* (W. Gams & Breton) Houbraken, Tanney, Visagie & Samson, *Aspergillus shendawei* (Yaguchi, Abliz & Y. Horie) Samson, Visagie & Houbraken, *Aspergillus similis* (Y. Horie, Udagawa, Abdullah & Al-Bader) Samson, Visagie & Houbraken, *Aspergillus tsunodae* (Yaguchi, Abliz & Y. Horie) Samson, Visagie & Houbraken.

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INTRODUCTION

Aspergillus is a diverse genus with high economic and social impact. Species occur worldwide in various habitats and they are known to spoil food, produce mycotoxins and are frequently reported as human and animal pathogens. Furthermore, many species are used in biotechnology for the production of various metabolites such as antibiotics, organic acids, medicines or enzymes, or as agents in many food fermentations. The classification and identification of *Aspergillus* has been based on phenotypic characters but in the last decades was strongly influenced by molecular and chemotaxonomic characterisation.

Micheli (1729) introduced the name *Aspergillus*, with Haller (1768) validating the genus and Fries (1832) sanctioning the generic name. *Aspergillus glaucus* (L.) Link [= *Mucor glaucus* L. \equiv *Monilia glauca* (L.) Pers.] is the generic type. In total, nine

teleomorph genera were traditionally linked to *Aspergillus* anamorphs (Pitt *et al.* 2000), one of these being *Eurotium* Link: Fr. typified by *Eurotium herbariorum* (Wiggers: Fr.) Link. The others were *Chaetosartorya* Subram., *Emericella* Berk., *Fennellia* B.J. Wiley & E.G. Simmons, *Hemicarpenales* A.K. Sarbhoy & Elphick (now considered to belong in *Penicillium*; Visagie *et al.* 2014a), *Neosartorya* Malloch & Cain, *Petromyces* Malloch & Cain, *Sclerocleista* Subram. (now considered distinct from *Aspergillus*; Houbraken & Samson 2011) and *Stilbothamnium* Henn. *Neopetromyces* Frisvad & Samson and *Neocarpenteles* Udagawa & Uchiy. were introduced more recently by Frisvad & Samson (2000) and Udagawa & Uchiyama (2002). Thom & Raper (1945) and Raper & Fennell (1965) published major monographic treatments on the genus *Aspergillus* and respectively accepted 89 and 150 species. They also disregarded teleomorphic names, contrary to the prevailing nomenclatural code,

using only the name *Aspergillus*. The List of “Names in Current Use” (NCU) for the family *Trichocomaceae* (Pitt & Samson 1993) accepted 185 anamorphic *Aspergillus* names and 72 associated teleomorphic names. Pitt *et al.* (2000) updated this list, accepting 184 *Aspergillus* and 70 associated teleomorphic names. Both lists were mainly based on the morphological species concept current at that time. However, the move towards a polyphasic species concept incorporating morphology, extrolite data and most importantly phylogenetic data, meant that this list quickly became out-dated. This is not only because new species were described since the late 1990's, but was also a reflection that many species previously considered synonyms based on morphology were shown to be phylogenetically distinct. Old names were thus often re-introduced as accepted, distinct species. As such, we consider updating the list of accepted species to be crucial for the taxonomic and nomenclatural stability of *Aspergillus*.

The infrageneric classification of the genus *Aspergillus* is traditionally based on morphological characters. Raper & Fennell (1965) divided the genus in 18 groups. The classification into groups does not have any nomenclatural status and therefore Gams *et al.* (1985) introduced names of subgenera and sections in *Aspergillus*. The phenotype based classification of subgenera and sections largely correspond with the current published phylogenies. Peterson (2008) accepted five subgenera and 16 sections in *Aspergillus*. Houbraken *et al.* (2014) and Hubka *et al.* (2014) currently proposed four subgenera (*Aspergillus*, *Circumdati*, *Fumigati* and *Nidulantes*) and 20 sections. Phylogenetic studies (Berbee *et al.* 1995, Ogawa *et al.* 1997, Tamura *et al.* 2000, Geiser *et al.* 2008, Peterson 2008, Peterson *et al.* 2008, Houbraken & Samson 2011) shed light on the relationships between *Aspergillus* species, but left questions regarding the generic concept unsolved. Because of the new single name nomenclature for fungi (McNeill *et al.* 2012), it is important to define the phylogenetic relationships of species in *Aspergillus* and closely related genera. Morphological identification of *Aspergillus* mostly follows the protocols of Raper & Fennell (1965), Klich (2002), Pitt & Hocking (2009) and Samson *et al.* (2010). Molecular tools, especially phylogenetic species recognition, are increasingly being used with the internal transcribed spacers of the nrDNA (ITS) now accepted as the official DNA barcode for fungi (Schoch *et al.* 2012). However, this locus is insufficient for correctly identifying all *Aspergillus* species and thus a secondary identification marker is needed. In this paper, we discuss different approaches for species identification in *Aspergillus*. We make recommendations for identifying and characterising *Aspergillus* species and recommend DNA markers for reliable species identification.

MONOPHYLY OF ASPERGILLUS

Aspergillus has been the subject of a large number of taxonomic studies using DNA sequence data. Many of these studies focused on specific groups (species, sections, subgenera) within *Aspergillus* and the number of phylogenetic studies at the genus level and above are limited. The first studies on the phylogeny of *Aspergillus* and related genera often used a limited number of strains and phylogenetic markers. Using a dataset of 17 strains, Berbee *et al.* (1995) studied the possible monophyly of *Penicillium* using ITS and 18S rDNA sequences. In this study, *Eupeenicillium javanicum* (= *Penicillium javanicum*), *Monascus*

purpureus, *Neosartorya fischeri* (= *A. fischeri*), *Eurotium rubrum* (= *A. ruber*) and *A. fumigatus* form a well-supported clade (98 % bootstrap value, bs) indicating the close relationship among these species. Furthermore, *A. ruber*, *A. fumigatus* and *A. fischeri* were placed together on a branch with moderate statistical support (77 % bs), indicating that *Aspergillus* is monophyletic. Similar results were found by Ogawa *et al.* (1997); in their phylogeny based on 18S rDNA data, *E. rubrum*, *N. fischeri* and *A. fumigatus* also formed a well-supported clade (99 % bs), distinct from *Penicillium* and *Monascus*. Tamura *et al.* (2000) determined the relationships within *Aspergillus* using 18S rDNA. Using a larger sample size, data indicate that *Aspergillus* is monophyletic, but the overall resolution was limited.

Peterson (2008) studied the phylogenetic relationships within *Aspergillus*. A phylogeny based on 5.8S rDNA, 28S rDNA and the *RPB2* sequences resolved *Aspergillus* into three main clades, but the relationship among these clades was not statistically supported. These clades roughly corresponded with the subgenera of *Aspergillus*, with one clade including the subgenera *Circumdati* and *Fumigati*, one representing subgenus *Nidulantes* and another containing members of subgenus *Aspergillus*. Similar results were obtained by Geiser *et al.* (2008), although they focused on *Aspergillus* below genus level. Using a 10-gene phylogeny, *Aspergillus* could be split in three main clades: subgenera *Circumdati*, *Fumigati* and *Nidulantes*. No strains belonging to subgenus *Aspergillus* were included in this study. The study of Peterson (2008) further showed that a clade comprising *Monascus* and *Hamigera* species was basal to *Aspergillus* (0.98 posterior probability, pp) and formed a polytomy with clades containing *Penicillium* and *Sclerocleista* species (1.00 pp).

The studies by Houbraken & Samson (2011) and Houbraken *et al.* (2014) used a four-gene phylogeny (*RPB1*, *RPB2*, *Tsr1* and *Cct8*) and were based on similar data sets. Using Maximum Likelihood analysis, both studies resolved *Aspergillus* and its teleomorphs in a monophyletic clade without statistical support (51 and 57 %). A Bayesian analysis was also performed in the study of Houbraken & Samson (2011) and in this analysis, *Aspergillus* and its sexual states formed a fully supported lineage (1.00 pp). This data is in agreement with that of Houbraken *et al.* (2014), where a 25-gene phylogeny shows the monophyly of *Aspergillus* and its teleomorphs (100 % bs). In common with the Peterson (2008) and Geiser *et al.* (2008) studies, the genus could be subdivided into several clades. Three of those clades (subgenera *Aspergillus*, *Nidulantes*, *Fumigati*) were fully supported in the Bayesian analysis (1.00 pp) and the clade representing subgenus *Circumdati* was moderately supported (0.94 pp). Interestingly, the type species of *Dichotomomyces*, *Polypaecilum* and *Phialosimplex* were related to members of sections *Cremeri* and *Aspergillus* (64 % bs, 1.00 pp), placing those genera within *Aspergillus*. This was unexpected, because species of the genera *Polypaecilum* and *Phialosimplex* do not produce typical *Aspergillus* conidiophores. *Phialosimplex* was introduced rather recently by Sigler *et al.* (2010). Species of this genus are closely related in their phylogenies (84 % MP, 18S rDNA; 89 % MP; ITS), and were phylogenetically set apart from *Aspergillus* and *Penicillium*, but with low or insignificant support. Based on the data of Houbraken & Samson (2011), combined with phenotypic and physiological characters, *Aspergillus* could be divided into six subgenera: *Circumdati*, *Nidulantes*, *Aspergillus*, *Fumigati*, *Polypaecili* and *Cremeri*. This was also supported in the study of Houbraken *et al.* (2014), where based on a 25-

gene phylogeny, *Aspergillus* and *Penicillium* resolved in two separate fully supported clades. Furthermore, *Aspergillus* could be divided into five clades (no representatives of *Phialosimplex* or *Polypaecilum* were included in this study).

Subgenera listed above are strongly linked with teleomorph genera. The teleomorph genus *Eurotium* is linked to subgenus *Aspergillus* and the genera *Petromyces*, *Neopetromyces* and *Fennellia* belong to subgenus *Circumdati*. *Neocarpenteles*, *Neosartorya* and *Dichotomomyces* belong to subgenus *Fumigati*; *Chaetosartorya* and *Cristaspora* to subgenus *Cremeri* and *Emericella* to subgenus *Nidulantes*. These subgenera also have distinct physiological and phenotypic characters and this data could advocate splitting the genus in six different genera.

Using a subset of sequences generated by [Houbraken & Samson \(2011\)](#), [Pitt & Taylor \(2014\)](#) re-analysed the phylogenetic relationships of *Aspergillus* and closely related genera. In their analysis, only members of the *Aspergillaceae* were included and Bayesian and ML analyses were performed. In the Bayesian analysis, the deeper nodes were generally well-supported; in contrast, the support for these nodes in the ML analysis was poor. Below the genus level, [Pitt & Taylor \(2014\)](#) found that *Penicillium* is a sister clade of *Nidulantes*, rendering *Aspergillus* a paraphyletic genus. Based on this and other data (phenotype, physiology) they advocated splitting *Aspergillus* into several genera in part to maintain the monophyly of, and the use of the name *Penicillium*. [Pitt & Taylor \(2014\)](#) speculated that the difference between their analysis and that of [Houbraken & Samson \(2011\)](#) was an improved alignment obtained by omitting more distantly related taxa. This seems unlikely, because the genes sampled consisted of exon sequence only, which results in alignments with almost no gaps. The reason for the inconsistencies among these studies remains unknown.

The deep, basal branches are often short and weakly supported in most studies dealing with the phylogeny of *Aspergillus* and related genera ([Houbraken & Samson 2011](#), [Houbraken et al. 2014](#), [Pitt & Taylor 2014](#)). Room exists for argument about the exact relationships among *Penicillium*, *Aspergillus* and related genera. Although based on a limited number of species, the phylogeny of [Houbraken et al. \(2014\)](#) confidently shows the monophyly of *Aspergillus*. An increase of sample size and the analysis of more loci will lead to increased statistical support of the deeper nodes. Based on the recent 25-gene phylogeny, *Penicillium* and *Aspergillus* are divided in two distinct well-supported genera, suggesting the monophyly of both genera ([Houbraken et al. 2014](#)). In the near future, genome sequence data will become available and analysis of this data will probably result in well-supported phylogenies.

THE *ASPERGILLUS* CONIDIOPHORE

As mentioned above, [Houbraken & Samson \(2011\)](#) demonstrated that the type species of *Polypaecilum* and *Phialosimplex* were related to members of sections *Cremeri* and *Aspergillus*, phylogenetically placing those genera within the classical concept of *Aspergillus*. This was unexpected, because species of *Polypaecilum* and *Phialosimplex* do not produce a typical *Aspergillus* conidiophore. [Pitt & Hocking \(1985\)](#) suggested that, “simultaneously produced phialides and a foot cell are absolute characters for assigning a species to the *Aspergillus* genus”. However, based on phylogenetic analyses, the production of an aspergillum-like conidial head does not guarantee that a given

species belongs to *Aspergillus*. For example, “*Aspergillus paradoxus*”, “*A. malodoratus*” and “*A. crystallinus*” produce conidial heads with a terminal vesicle reminiscent of *Aspergillus*, yet belong to *Penicillium* subgenus *Penicillium* ([Houbraken & Samson 2011](#), [Visagie et al. 2014a](#), [2014b](#)). On the other hand, species lacking typical *Aspergillus*-like asexual structures are nested within the *Aspergillus* clade ([Houbraken & Samson 2011](#)). An example is *Penicillium inflatum* ([Stolk & Malla 1971](#)), which produces *Penicillium*-like conidial heads, although it belongs to *Aspergillus* section *Cremeri*. Recent multilocus phylogenetic studies also clarified that genera with conidial heads that are dramatically different from a typical aspergillum, such as *Dichotomomyces* ([Saito 1949](#), [Scott 1970](#)), *Phialosimplex* ([Sigler et al. 2010](#)), *Polypaecilum* ([Smith 1961](#)) and *Cristaspora* ([Fort & Guarro 1984](#)) are nested within the broadly defined, monophyletic *Aspergillus* clade ([Varga et al. 2007a](#), [Peterson 2008](#), [Houbraken & Samson 2011](#)). Moreover, there are some *Aspergillus* species that do not produce asexual structures, which makes it difficult to assign them to a genus usually recognised by asexual morphological characters. An example is *A. monodii* (syn. *Fennellia monodii*; [Locquin-Linard 1990](#)), which is assigned to *Aspergillus* section *Usti* based on a polyphasic taxonomic approach ([Samson et al. 2011](#)). Repeated attempts were made to induce conidiogenesis in this species, without success. Additionally, several genera have conidial heads resembling vesiculate *Aspergillus* conidiophores and/or with branching similar to *Penicillium*, including *Paecilomyces* ([Samson et al. 2010](#)), *Goidanichiella* ([Kwasna & Behnke-Borowczyk 2010](#)), or *Nalanthamala* ([Schroers et al. 2005](#)). These genera are unrelated or only distantly related to *Aspergillaceae*.

Previous studies on the genetics and molecular biology of conidiogenesis in *A. nidulans* and other aspergilli provide another proof that the production of an aspergillum is neither sufficient nor a prerequisite to assign a species to *Aspergillus*, because mutations in the developmental pathway lead to the formation of conidium-bearing structures not resembling an aspergillum. *Aspergillus nidulans* is a model fungus for the examination of the genetics and molecular biology of conidiophore development ([Clutterbuck 1969](#), [Miller 1993](#), [Adams et al. 1998](#)). Several genes take part in this process (for details, see [Adams et al. 1998](#), [Harris 2012](#)) and conidiogenesis is under complex genetic control. In *A. nidulans*, *FluG* (associated with the production of a small diffusible molecule) and *FibA* (regulator of G-protein signalling) are upstream activators of conidiation ([Adams et al. 1998](#)). Several additional downstream transcription factors (*FibB*, *FibC*, *FibD*, *FibE*) are required for transcriptional activation of the key component of the pathway, the transcription factor *BrlA*. This factor activates the transcription factors *AbaA* and *WetA* in the pathway that includes multiple feedback loops and is regulated by additional modifiers (e.g. *MedA* and *StuA*; [Adams et al. 1998](#), [Harris 2012](#)). Most components of the pathway are conserved in other *Aspergillus* and *Penicillium* species, suggesting that this regulatory network has been conserved within the *Aspergillaceae* ([Borneman et al. 2000](#), [Yu et al. 2006](#), [Ogawa et al. 2010](#), [Yu 2010](#), [Sigl et al. 2011](#)). Mutations in these genes can lead to dramatic changes in the morphology of the conidial head ([Harris 2012](#)). A mutation in a tyrosine kinase gene (*AnkA*) or the cyclin-dependent cyclase *nimX* leads to the appearance of septa in the stalk, absence of a terminal vesicle, and the failure to produce proper metulae and phialides because of a failure to undergo the transition from “hyphal-like” to “yeast-like” growth ([Ye et al. 1997](#), [1999](#), [Harris 2012](#)). Mutations in the *RgaA* locus

(homologue of the yeast GTPase-activating protein *Rga1*) lead to abnormal conidiophores that do not possess a terminal vesicle and form metulae that resemble hyphae (Harris 2012). Other mutations can also lead to the transition of *Aspergillus*-like conidial heads to *Penicillium*-like heads, including deletion mutants of *nimX* (Harris 2012) or a Pcl-like cyclin (Schier et al. 2001), and other mutants described in the literature like the Abnc and V103 mutants of *A. nidulans* (Giancoli & Pizzinari-Kleiner 2004, Giancoli et al. 2010).

Apart from the typical aspergillum, several *Aspergillus* species produce other types of conidium-bearing structures. Several *A. versicolor* and *A. sydowii* isolates consistently produce diminutive conidial heads, which resemble penicillate (*Penicillium*-like) conidiophores (Raper & Fennell 1965). *Aspergillus implicatus* (section *Usti*, Samson et al. 2011), *A. unilateralis* (section *Fumigati*, Samson et al. 2007), *A. candidus* and other species in section *Candidi* (Varga et al. 2007b) produce diminutive conidial heads that are frequently uniseriate, in contrast with the larger biseriate heads, and sometimes reminiscent of *Penicillium* heads, while *A. terreus* (Deak et al. 2009, 2011), *A. flavipes*, *A. niveus* (Pore & Larsh 1968) and *A. alabamensis* (Burrough et al. 2012) isolates frequently produce accessory conidia in addition to the typical conidial heads.

We suggest that the conidium-bearing apparatus of species of *Dichotomomyces*, *Phialosimplex* and the type species of *Polypaecilum* (Fig. 1), which form part of the monophyletic *Aspergillus* clade, evolved from *Aspergillus*-like conidial heads by mutations in the regulatory genes. Harris (2012) proposed that the *Aspergillus*-like conidial head might have evolved from a penicillus producing ancestor. Moreover, the observations that mutations in several genes taking part in the control of conidiogenesis can lead to the transition of an aspergillum to structures resembling a penicillus, indicate that the aspergillum is more ancient than a penicillus. Full genome sequencing of these isolates would enable studies aimed at determining the molecular basis for these differences, and would help to understand the evolution of conidiophore development in the *Aspergillaceae*.

In conclusion, the production of *Aspergillus*- or *Penicillium*-like conidial heads is essential for assigning a species to a given genus. The polythetic morphological definition of both *Aspergillus* and *Penicillium* adopted in this paper acknowledges that while certain conidiophore patterns are typical of 90 % or more of the included species, other patterns may occur in a minority of species. Recent data indicate that a polyphasic approach should be used for species assignment including sequence-based identification (Samson et al. 2007).

NOMENCLATURE OF ASPERGILLUS AND ITS SEXUAL MORPHS

Recently, a proposal to dramatically revise article 59 of the former botanical code was accepted by the 2011 International Botanical Congress Nomenclature Section at Melbourne and the principle of "one fungus : one name" was established (Norvell 2011, McNeill et al. 2012). These new nomenclatural rules have large implications for *Aspergillus* and several options were considered by a meeting of the International Commission of *Penicillium* and *Aspergillus* (ICPA) in April 2012. In this paper, we review the arguments leading to our decision to maintain the prevailing, broad concept of *Aspergillus*, with the modifications included in the diagnosis below.

One option is to split *Aspergillus* into several clades and use the oldest genus name associated with the resulting genera, such as *Neosartorya*, *Emericella*, *Petromyces*, etc. The type species of *Aspergillus* is *A. glaucus* (section *Aspergillus*). This would mean that the name *Eurotium* would be lost and the genus name *Aspergillus* would be applied only to this clade. Species in other clades, such as in section *Fumigati* would be renamed as *Neosartorya*, subgenus *Nidulantes* as *Emericella* and subgenus *Circumdati* as *Petromyces*, although there may be older anamorph generic names for each clade (cf. Seifert et al. 2011). Pitt & Taylor (2014) argued for using *Aspergillus*, in place of *Petromyces* for subgenus *Circumdati* because no more than five of the many currently accepted species possess a known sexual state in *Petromyces*, while several of these commonly occurring species, such as *A. niger*, *A. ochraceus* and *A. flavus*, are economically important. These arguments are debatable because the same argument could be used for section *Fumigati* where the medical community could have problems accepting the *Neosartorya* name.

Option two follows from the first option to split *Aspergillus* into several genera with different (teleomorph) names, and conserve *Aspergillus* with another type species (e.g. *A. fumigatus* or *A. niger*). If *A. niger* were chosen, the genus name *Aspergillus* could be used for e.g. *A. niger*, *A. flavus*, *A. oryzae*, while *Emericella*, *Neosartorya* and *Eurotium* would then be used for species in sections *Versicolores*, *Fumigati* and *Aspergillus* (*Emericella* for *E. nidulans* and *A. versicolor*, *Neosartorya* for *A. fumigatus* and *A. clavatus*, and *Eurotium* for *E. herbariorum* and *A. penicillioides*). The selection of a type other than *A. glaucus* would provoke debate, because the choice would depend on the economic phenomenon of interest, e.g. *A. fumigatus* for medical mycology, *A. flavus* for food and mycotoxin related research or *A. nidulans* because of its use as a genetic model. The proposal to select a type other than *A. glaucus* would have to be prepared for the Nomenclatural Committee for the 2017 International Botanical Congress without the support of the International Commission of *Penicillium* and *Aspergillus* (ICPA). It would cause further instability and nomenclatural confusion.

Option three is to keep the name *Aspergillus* and treat other (teleomorph) names to indicate structures with biological significance, but always together with the *Aspergillus* name. e.g. *Aspergillus glaucus* with eurotium-type ascomata, or *Aspergillus fischeri* (neosartorya-type fruiting bodies). This option was chosen by ICPA on April 11, 2012 (<http://www.aspergilluspenicillium.org/images/PDF/minutes.pdf>). The consequence of this choice is that the majority of *Aspergillus* names, including their teleomorphs will keep their *Aspergillus* name, contributing to nomenclatural stability. The option to treat *Aspergillus* as one genus is strongly supported by the results of phylogenetic analyses that the genus is monophyletic with minor modifications to the classical concept needed. As discussed above, the small genera *Dichotomomyces*, *Polypaecilum* and *Phialosimplex* should be considered synonyms of *Aspergillus*.

The consequence of the single-name system is that teleomorph-based genera, such as *Neosartorya*, *Emericella*, *Eurotium*, and *Petromyces*, are synonymised with *Aspergillus*. This nomenclature is already being adopted in the recently published *Aspergillus* taxonomies. Hubka et al. (2013a) used a single-name nomenclature in their revision of the genus *Eurotium* and all accepted *Eurotium* taxa were listed under their *Aspergillus* names. Examples of species producing sexual states, but described as *Aspergillus* include *A. waksmanii* (Hubka et al.

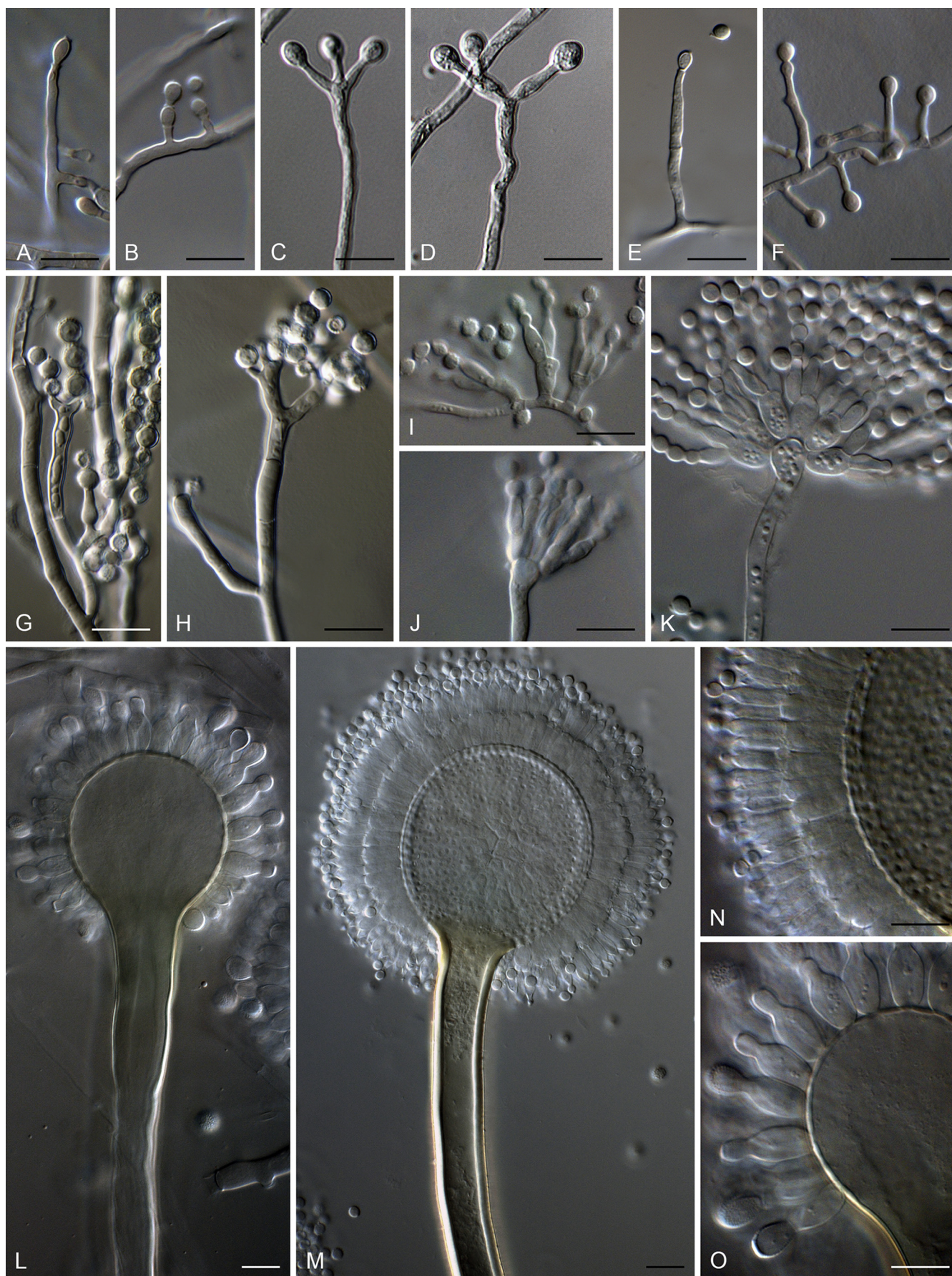


Fig. 1. Range of conidiophore phenotypes, which phylogenetically belong in *Aspergillus*. A, B. *Basipetospora halophila* (CBS 232.32). C, D. *Dichotomomyces cejpji* (CBS 157.66). E. *Phialosimplex* sp. (WL04MI-422). F. *Phialosimplex caninus* (CBS 128032). G, H. *Polypaecilum insolitum* (CBS 384.61). I. Diminutive conidiophores in *Aspergillus arenarioides* (CBS 138200). J, K. Diminutive conidiophores in *A. subalbidus* (CBS 567.65). L, O. *Aspergillus sloanii* (CBS 138177). M, N. *Aspergillus ochraceus* (CBS 108.08). Scale bars: A–O = 10 μ m.

2013b), *A. felis* (Barrs et al. 2013), *A. huiyanae* (Matsuzawa et al. 2014a), *A. siamensis* (Eamvijarn et al. 2013), *A. caatingaensis* and *A. pernambucoensis* (Matsuzawa et al. 2014b), and *A. wyomingensis* (Nováková et al. 2014) for species with a neosartorya-type sexual morph, while *A. cibarius* (Hong et al. 2012), *A. osmophilus* (Asgari et al. 2014) and *A. cumulatus* (Kim et al. 2014) were introduced for species with a eurotium-type sexual state.

RECOMMENDED METHODS FOR THE IDENTIFICATION AND CHARACTERISATION OF *ASPERGILLUS*

Morphological species recognition

Morphological characters

Morphology forms an important part of the species concept of *Aspergillus*. Colony characters used for characterising species include colony growth rates, texture, degree of sporulation, production of sclerotia or cleistothecia, colours of mycelia, sporulation, soluble pigments, exudates, colony reverses, sclerotia, Hülle-cells and cleistothecia. Both sexual and asexual reproduction occurs in *Aspergillus* and the microscopic features of these structures are important. Diagnostic conidiophore characters include the shape of conidial heads, the presence or absence of metulae between vesicle and phialides (i.e. uniseriate or biseriate), colour of stipes, and the dimension, shape and texture of stipes, vesicles, metulae (when present), phialides, conidia and Hülle-cells (when present). The same applies for cleistothecia, asci and ascospores. For cleistothecia, the development of ascomata and the way their walls are produced is also an important character. Ascospore sizes and morphology, particularly the often diagnostic ornamentation (roughening, rims, wings, furrows, etc.) are important for identifying species. Media, inoculation technique and incubation conditions affect morphological characters (Okuda 1994, Okuda et al. 2000). We recommend the following standardised method for laboratories working with *Aspergillus* (summarised in Fig. 2).

Inoculations

Inoculations are made from spore suspensions prepared in a 30 % glycerol SS-buffer (0.5 g/l agar, 0.5 g/l Tween 80) solution, which can be stored at -80°C . Alternatively, spore suspensions can be made in a 0.2 % agar and 0.05 % Tween 80 solution, and stored at 4°C . Plates are inoculated in three-point pattern using a micropipette and inoculum size of 0.5–1 μl per spot.

Medium preparation

For media preparation, we recommend using 90 mm Petri dishes with 20 ml medium per plate (Okuda 1994, Okuda et al. 2000). Glass Petri dishes were used traditionally, but vented or unvented polystyrene dishes have mostly replaced these. Vented Petri dishes allows for more oxygen transfer and thus more typical conidiophore morphology than unvented dishes. However, not all institutions use vented dishes. Media recommended as standard for *Aspergillus* include Czapek Yeast Autolysate agar (CYA) and Malt Extract agar (MEA, Oxoid). Although we propose the use of Oxoid MEA, many laboratories use Difco. It is thus important to mention in descriptions which

brand of malt extract is used. In addition, two different MEA formulations are used in recent descriptions. Blakeslee's (1915) MEA is traditionally used because it was a standard used by Raper & Fennell (1965), but CBS uses a differently formulated MEA (summarised in Table 1) from which a large number of species has been described recently. It is thus important to also note this formulation in species descriptions. To observe a wider range of characters it is useful to use additional media, including Czapek's agar (CZ), 20 % sucrose CYA (CY20S), 20 % sucrose MEA (MEA20S), Yeast Extract Sucrose agar (YES), Dichloran 18 % Glycerol agar (DG18), Oatmeal agar (OA) and Creatine Sucrose agar (CREA). CZ was used by Raper & Fennell (1965) in their taxonomic treatment and is still widely used today. However, lately CYA has been more widely used. Media such as CY20S, ME20S and DG18 allow for growth of xerophilic *Aspergilli*, mostly classified in section *Aspergillus*, and are useful for the full development of diagnostic characters of these species. YES, together with CYA, is required for extrolite profiling of strains discussed below. Sexual reproductive structures are more readily produced on OA and thus can add valuable taxonomic information, even though we are aware that OA is very difficult to standardise across different laboratories. We do suggest, however, that pre-fabricated OA formulations or precooked oats ("3 minute oats") are unsuitable, and for best results organic uncooked oats should be used. Acid production is often a useful character and this is observed on the purple medium CREA, which turns yellow when acid is produced by colonies. For consistent conidial colours, the addition of zinc-sulphate and copper-sulphate as trace elements (1 g $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ and 0.5 g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in 100 ml distilled water) is of utmost importance because these metals vary widely in water sources in different locations and are critical for pigment production. Analytical grade inorganic chemicals are recommended for medium preparations. For optimal colony growth and colour, the type of agar plays also an important role and in some cases strongly influences these phenotypic characters. It is therefore important to test the agar for consistent character development. After extensive comparisons, So-BI-Gel agar (Bie & Berntsen, BBB 100030) is used at CBS. Medium formulations are summarised in Table 1.

Incubation

Inoculated CYA and MEA plates are incubated reverse side up at 25°C , with additional CYA plates incubated at 30 and 37°C . In section *Circumdati*, characters on CYA at 33°C have been shown to be taxonomically informative (Yilmaz et al. 2014, Visagie et al. 2014b), while growth on CYA at 45 – 50°C is informative for section *Fumigati*. Plates should be kept in the dark and to allow for sufficient aeration they should not be wrapped with Parafilm (Okuda et al. 2000). For standard bench top incubators, plates should not be placed in plastic boxes. Many laboratories use walk-in incubators where plates must be incubated in plastic boxes. In these cases, care should be taken to allow for sufficient aeration by, for example, not having too many plates in one box. Incubation times are standardised at seven days, after which colony growth rates and other characters should be recorded. Additional important characters are often observed by incubating cultures for longer periods of time, in particular characters of sclerotia or ascomata. In these cases it should be noted in descriptions.

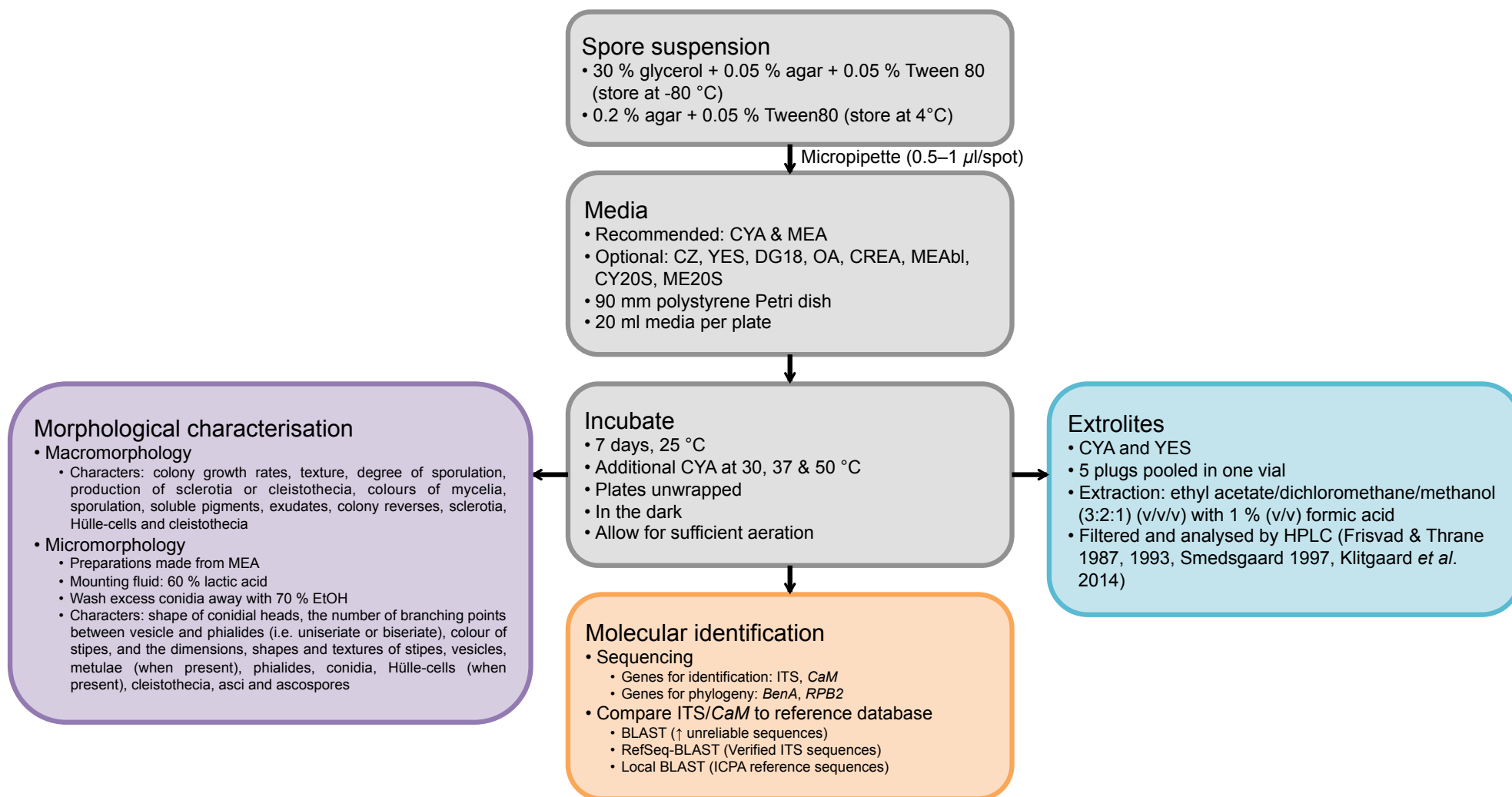


Fig. 2. Flow diagram summarising recommended methods for the identification and characterisation of *Aspergillus*. Frisvad & Thrane (1987, 1993), Smedsgaard (1997) and Klitgaard *et al.* (2014), refer to methods described for detecting extrolites in fungi.

Table 1. Media used for morphological characterisation.**Czapek stock solution (100 ml) (Pitt 1979)**

NaNO ₃	30 g
KCl	5 g
MgSO ₄ ·7H ₂ O	5 g
FeSO ₄ ·7H ₂ O	0.1 g
dH ₂ O	100 ml

*Store at 4–10 °C

Trace elements stock solution (100 ml)

CuSO ₄ ·5H ₂ O	0.5 g
ZnSO ₄ ·7H ₂ O	0.1 g
dH ₂ O	100 ml

*Store at 4–10 °C

Blakeslee's Malt extract agar (MEAbI, Blakeslee 1915)

Malt extract (Oxoid)	20 g
Peptone (Oxoid)	1 g
Glucose	20 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
Agar	20 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min. pH 5.3 ± 0.2.

Creatine sucrose agar (CREA, Frisvad 1981)

Sucrose	30 g
Creatine·1H ₂ O	3 g
K ₃ PO ₄ ·7H ₂ O	1.6 g
MgSO ₄ ·7H ₂ O	0.5 g
KCl	0.5 g
FeSO ₄ ·7H ₂ O	0.01 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
Bromocresol purple	0.05 g
Agar	20 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min. pH 8.0 ± 0.2.

Czapek's agar (CZ, Raper & Thom 1949)

Czapek concentrate	10 ml
Sucrose	30 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.001 g
Agar	20 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min.

Czapek Yeast Autolysate agar (CYA, Pitt 1979)

Czapek concentrate	10 ml
Sucrose	30 g
Yeast extract (Difco)	5 g
K ₂ HPO ₄	1 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
Agar	20 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min. pH 6.2 ± 0.2.

Table 1. (Continued).**CYA with 20% sucrose agar (CY20S, Klich 2002)**

Czapek concentrate	10 ml
Sucrose	200 g
Yeast extract (Difco)	5 g
K ₂ HPO ₄	1 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
Agar	20 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min. pH 5.4 ± 0.2.

Dichloran 18% Glycerol agar (DG18, Hocking & Pitt 1980)

Dichloran-Glycerol-agar-base (Oxoid)	31.5 g
Glycerol (anhydrous)	220 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
Chloramphenicol	0.05 g
Agar	20 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min. After autoclaving, add 0.05 chlortetracycline. pH 5.6 ± 0.2.

Malt Extract agar (MEA, Samson et al. 2010)

Malt extract (Oxoid CM0059)	50 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
dH ₂ O	1000 ml

*Mix well and autoclave at 115 °C for 10 min. pH 5.4 ± 0.2.

Malt Extract 20% Sucrose agar (M20S, Samson et al. 2010)

Malt extract (Oxoid CM0059)	50 g
Sucrose	200 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
dH ₂ O	1000 ml

*Mix well and autoclave at 121 °C for 15 min. pH 5.4 ± 0.2.

Oatmeal agar (OA, Samson et al. 2010)

Oatmeal flakes	30 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.01 g
Agar	20 g
dH ₂ O	1000 ml

*First autoclave flakes (121 °C for 15 min) in 1000 ml dH₂O. Squeeze mixture through cheese cloth and use flow through, topping up to 1000 ml with dH₂O with 20 g agar. Autoclave at 121 °C for 15 min. pH 6.5 ± 0.2.**Yeast extract sucrose agar (YES, Frisvad 1981)**

Yeast extract (Difco)	20 g
Sucrose	150 g
MgSO ₄ ·7H ₂ O	0.5 g
CuSO ₄ ·5H ₂ O	0.005 g
ZnSO ₄ ·7H ₂ O	0.001 g
Agar	20 g
dH ₂ O	885 ml

*Mix well and autoclave at 121 °C for 15 min. pH 6.5 ± 0.2.

Microscopy

As a standard, microscopic observations are made from conidiophores produced on MEA after 7–10 d, although other media can also be used when stated in descriptions. OA is good for observing cleistothecia in sexually competent species. Lactic acid (70 %) or Shear's solution works well as a mounting fluid (Samson *et al.* 2010). Lactophenol is corrosive and the phenol toxic, and as a result is not recommended as a mountant for slides. *Aspergillus* conidia are hydrophobic. As such, mounts can be washed with drops of 70 % ethanol to wash away excess conidia and prevent air-bubbles from being trapped. Fine needles can be used to tease apart tufts of conidiophores. For best observation of conidiophore characters, differential interference contrast microscopy (= Nomarski) is suggested when possible; we note that *Aspergillus* conidiophores are often birefringent, exhibiting colours that are artefacts of polarised light under DIC illumination and not indicative of pigmentation.

Molecular species recognition

Identification markers

The nuc rDNA internal transcribed spacer rDNA region (ITS1-5.8S-ITS2) is the official DNA barcode for fungi (Schoch *et al.* 2012), because it is the most frequently sequenced marker in fungi and has primers that work universally. As such, it is good practise to include ITS sequences whenever new species are described, although it sometimes does not contain enough variation for distinguishing among all species (Schoch *et al.* 2012). An ITS phylogeny of *Aspergillus* is provided as supplementary material (Fig. S1) to demonstrate the lack of variation in some clades. As such, a secondary barcode or identification marker usually is needed to identify an *Aspergillus* culture to species with confidence.

The secondary marker, similarly to ITS, should make use of universal primers, be easy to amplify and in contrast to ITS, should distinguish among all species. Another important consideration is the completeness of the current database available for each gene, i.e. how many species have in fact been

sequenced. Based on these criteria, there are three realistic options, namely calmodulin (*CaM*), β -tubulin (*BenA*) or the RNA polymerase II second largest subunit (*RPB2*). *RPB2* is not easy to amplify, rendering its use as secondary identification marker frustrating. In contrast, *BenA* is easy to amplify, but has been reported to vary in the number of introns and PCR sometimes results in the amplification of paralogous genes (Peterson 2008, Hubka & Kolarik 2012). A similar problem was noted in a strain of *A. udagawae* (CCF 4477), where available *CaM* primers amplified a pseudogene and the resulting phylogeny had a very long branch for this strain in the *A. udagawae* clade (Nováková *et al.* 2013). Otherwise, *CaM* is easy to amplify, distinguishes among all *Aspergilli* (except for *A. elegans* and *A. steynii*, where ITS distinguishes between them, Visagie *et al.* 2014b), as demonstrated in the gene tree included as supplementary material (Fig. S2). In addition, the *CaM* sequence database is almost complete for all accepted species. As such, from a practical point of view, we suggest the use of *CaM* as a temporary secondary identification marker in *Aspergillus*. A case study for *CaM* in the section *Nigri* is provided below. Primers and thermal cycle protocols commonly used for PCR amplification are summarised in Table 2.

A common problem experienced with sequence-based identifications is comparing newly obtained sequences with verified sequence databases. GenBank is a public, archival database, meaning that it accepts all sequences submitted and cannot always verify the taxonomic names attributed to the sequences. This results in BLAST searches that often give hits to misidentified sequences in the database. In a step towards cleaning up misidentified GenBank sequences, the RefSeq initiative was launched (<http://www.ncbi.nlm.nih.gov/refseq/>), which contains only verified ITS sequences (Schoch *et al.* 2014). For *Aspergillus*, all ex-type sequences were included in the RefSeq database. This should result in a great improvement of species identification based on ITS. However, for alternative genes there is no such database. In an attempt to aid identifications, GenBank accession numbers for *CaM* sequences of ex-type species are added to the accepted species list presented below. We have also included representative *BenA* and *RPB2*

Table 2. Primers and annealing temperatures used for amplification and sequencing.

Locus	Amplification	Annealing temp (°C)	Cycles	Primer	Direction	Primer sequence (5'–3')	Reference
Internal Transcribed Spacer (ITS)	standard	55 (alt. 52)	35	ITS1	Forward	TCC GTA GGT GAA CCT GCG G	White <i>et al.</i> 1990
				ITS4	Reverse	TCC TCC GCT TAT TGA TAT GC	White <i>et al.</i> 1990
				V9G	Forward	TTA CGT CCC TGC CCT TTG TA	de Hoog & Gerrits van den Ende 1998
				LS266	Reverse	GCA TTC CCA AAC AAC TCG ACT C	Masclaux <i>et al.</i> 1995
β -tubulin (<i>BenA</i>)	standard	55 (alt. 52)	35	Bt ₂ a	Forward	GGT AAC CAA ATC GGT GCT GCT TTC	Glass & Donaldson 1995
				Bt ₂ b	Reverse	ACC CTC AGT GTA GTG ACC CTT GGC	Glass & Donaldson 1995
Calmodulin (<i>CaM</i>)	standard	55 (alt. 52)	35	CMD5	Forward	CCG AGT ACA AGG ARG CCT TC	Hong <i>et al.</i> 2005
				CMD6	Reverse	CCG ATR GAG GTC ATR ACG TGG	Hong <i>et al.</i> 2005
				CF1	Forward	GCC GAC TCT TTG ACY GAR GAR	Peterson <i>et al.</i> 2005
				CF4	Reverse	TTT YTG CAT CAT RAG YTG GAC	Peterson <i>et al.</i> 2005
RNA polymerase II second largest subunit (<i>RPB2</i>)	touch-up	50–52–55 (alt.:48–50–52)	5–5–30	5F	Forward	GAY GAY MGW GAT CAY TTY GG	Liu <i>et al.</i> 1999
				7CR	Reverse	CCC ATR GCT TGY TTR CCC AT	Liu <i>et al.</i> 1999
				5Feur	Forward	GAY GAY CGK GAY CAY TTC GG	Houbraken <i>et al.</i> 2012
				7CReur	Reverse	CCC ATR GCY TGY TTR CCC AT	Houbraken <i>et al.</i> 2012

sequences when they are available. These can be downloaded from GenBank and used for creating a local BLAST file to aid in faster and more accurate identifications.

Case study: calmodulin in section *Nigri*

Partial calmodulin gene sequences of about 1500 strains of *Aspergillus* section *Nigri*, previously amplified and aligned using the software package BioNumerics 5.1 (Applied Maths) with manual adjustments as necessary, were subjected to homology screening using the same software to assemble a reduced data set representative of the entire population of sequenced strains. This reduced panel of 129 DNA sequences, representative for the known diversity among 1438 strains of section *Nigri*, were aligned by Clustal W (Thompson *et al.* 1994) using MEGA version 5 (Tamura *et al.* 2011) and analysed to generate phylogenetic trees in MEGA version 5 (Fig. 3). Both the Neighbor-Joining (NJ) method (Saitou & Nei 1987) and the Maximum Likelihood (ML) method based on the Tamura-Nei model (Tamura & Nei 1993) were used. The analyses confirmed the existence of 25 well defined species clades in section *Nigri*. The aligned data set was exported to FASTA format for analysis of sequence diversity and polymorphism using the DnaSP v5 software (Librado & Rozas 2009). The software generated a haplotype data file that demonstrated the presence of 70 different haplotypes (see below) among the 129 representative strains, with the number of aligned sites in the complete data file being 536, with 188 single-nucleotide polymorphisms (SNPs) detected. An assembly of the 188 SNPs generated as a NEXUS file permitted a comparison of the differences in each haplotype, to identify fixed SNPs for each species of section *Nigri*. The analysis and comparison of these SNPs led to the identification of the following polymorphic nucleotides conserved at the species level, identified by their relative position in the full 536 bp alignment (included as supplementary material; Fig. S3):

SNPs fixed for *Aspergillus* section *Nigri* uniseriate species (nucleotide position and letter):

76 T, 81 A, 84 C, 115 T, 116 A, 179 A, 225 T, 249 A, 252 A, 268 T, 387 A, 411 T, 417 T, 420 C, 429 G

SNPs fixed for *Aspergillus* section *Nigri* biseriate species (nucleotide position and letter):

84 T, 115 G, 116 G, 179 G, 249 C, 252 G, 268 C, 411 C, 420 T, 429 A

SNPs fixed for *A. niger/welwitschiae* complex species (nucleotide position and letter):

64 G, 91 T, 291 T, 381 T

SNPs fixed for *A. welwitschiae* in respect to *A. niger* (nucleotide position and letter):

202 T, 209 T, 519 T

Specific SNPs unique or combination of position for the different species (nucleotide position and letter):

A. brasiliensis: 80-81-82 A-C-C, 181 A, 236 G.

A. costaricensis: 316 G.

A. carbonarius: 78 A, 236 A, 404-405 A-A, 413-414 A-A.

A. ellipticus: 80 T, 412 T, 74-75-76-77 G-G-G-G.

A. floricola: 128 C, 383 C.

A. heteromorphus: 79 C, 80 C, 89-91 T-A, 232-233 C-T, 206-208-209 T-A-A, 216-217-218 A-C-C.

A. homomorphus: 223 C, 238 C, 403 G, 415 G 381-382-383 A-C-G.

A. ibericus: 133 T, 160 T, 218-219 C-T.

A. japonicus: 516 T.

A. luchuensis (= *A. acidus*)/*A. piperis*: 83 T, 137 T, 151 C in *A. luchuensis*, and T in *A. piperis*.

A. saccharolyticus: 185 A, 198 G.

A. sclerotii carbonarius: 108 T, 137 G.

A. sclerotiger: 92 G, 202-203 T-T, 416-417-419 C-A-G.

A. trinidadensis: 261 G.

A. uvarum: 204-205-206-208 C-A-C-T.

A. vadensis: 161 A, 217 T.

A. welwitschiae: 209 T.

The other species not included, such as *A. aculeatinus*, *A. aculeatus*, *A. fijiensis/brunneoviolaceus*, *A. indologenus*, *A. japonicus*, *A. neoniger*, *A. tubingensis*, lacked unique species specific SNPs within the section *Nigri*, but a combination of SNPs differentiates all from closely related sister species:

A. tubingensis/A. neoniger: 204-205-206-222 CATT in *A. neoniger* and CCTA in *A. tubingensis*.

A. japonicus/A. indologenus: 339-342-366-369 CTTC in *A. indologenus* and CCTT in *A. japonicas*.

A. aculeatinus: 158-159-160-161-175-176 CCACAA.

A. aculeatus: 194 T, 342-354-357-360 TTCT.

A. fijiensis/A. brunneoviolaceus: 483-486 CT.

Some combinations of SNPs were identified for a unique and atypical strain of *A. aculeatus* (ITEM 4760 = CBS 620.78), but we cannot determine whether they are species specific or strain specific, or whether this strain available might represent a yet unidentified, distinct species in the *A. aculeatus* clade. The haplotype analysis presented shows *CaM* sequences have fixed SNP's that is unique and specific to species and that the gene is suitable for identifying isolates in the section *Nigri*.

Extrolite data

Isolates of *Aspergillus* species usually produce a diverse range of secondary metabolites that are characteristic of the different groups of sections of *Aspergillus*. For example, isolates of species of *Aspergillus* section *Flavi* nearly all produce kojic acid (Varga *et al.* 2011), while species in other sections produce other small acidic molecules, e.g. penicillic acid by most species of *Aspergillus* section *Circumdati* (Frisvad *et al.* 2004). Specific secondary metabolites are often only found in one section of *Aspergillus*, but some important extrolites, such as ochratoxin A, are produced by species in sections *Flavi*, *Circumdati* and *Nigri* (Frisvad *et al.* 2004, 2011, Varga *et al.* 2011). Production of a particular secondary metabolite is thus an efficient identification aid for allocating a species to section, while several identified secondary metabolites can be very effective in identifying an *Aspergillus* isolate to species. Although polyphasic identification is recommended, secondary metabolite profiles occasionally may be sufficient to identify isolates of *Aspergillus* to species. A qualitative database on the verified production of secondary metabolites by different species of *Aspergillus* is required to enable identification of *Aspergillus* isolates based only on this methodology. Furthermore, growth media and conditions, and analytical procedures must be standardised, but several papers contain recommendations on how to extract, separate and identify secondary metabolites (Nielsen *et al.* 2011a, Kildgaard *et al.* 2014, Klitgaard *et al.* 2014). It is important to note that although normal identification media often yield secondary



Fig. 3. Phylogenetic tree obtained with 188 polymorphic sites and fixed SNPs (conserved in spp.) derived from the calmodulin sequences of strains representative of the genetic variability of the 25 recognised species in *Aspergillus* section *Nigri* (* = type strains).

metabolites, different media may give very different profiles of secondary metabolites (Nielsen *et al.* 2011b).

Misidentifications in *Aspergillus*

It is critical that *Aspergillus* isolates used for reports of new or interesting extrolites be properly identified. Unfortunately, many strains continue to be misidentified, resulting in chemical data that is linked to an incorrect species name. More seriously, when regulated mycotoxins such as ochratoxin A or aflatoxin are attributed to misidentified species, regulatory officials may include the incorrect names in quarantine legislation, or initiate food-safety recalls based on scientifically inaccurate information. An early example of the misattribution of toxins to a species involved an entomogenous strain of *A. flavus* that infected pupa of a wax moth, and was reported to produce asperflavin, anhydroasperflavin, the mycophenolic acid precursor 5,6-dihydroxy-4-methylphthalide and asperentins (Grove 1972a,b, 1973). The strain was explicitly reported not to produce aflatoxins, and chemical data indicate that the strain was *A. pseudoglaucus* (formerly *Eurotium repens*). A recent example is a strain identified as *Aspergillus sydowii* (PFW1, strain unavailable) that was reported to produce 17 secondary metabolites from different biosynthetic families (Zhang *et al.* 2008) that are typical of *A. fumigatus* (Frisvad *et al.* 2009); the culture was probably a typical *A. fumigatus* strain. Similarly, a fungus identified as *A. varicolor* (B-17, strain unavailable) produced 23 metabolites (Wang *et al.* 2007) all typical of *Aspergillus* section *Aspergillus*. The fungus was reported as halotolerant, and was most probably a species with a *Eurotium*-like sexual state, but the new metabolites were unfortunately all named after *A. varicolor* (varicolorins A-L).

In some cases, these problems were caused by mixed or contaminated cultures. For example, a series of *A. niger* extrolites (Nielsen *et al.* 2009) were reported from *Cladosporium herbarum* (Ye *et al.* 2005) and *Pestalotiopsis theae* (Ding *et al.* 2008). Although the original cultures may have been correctly identified (unfortunately, they were not deposited in a culture collection), these strains were obviously contaminated with black aspergilli, because the metabolites that were structurally elucidated or identified have never been otherwise attributed to any *Cladosporium* or *Pestalotiopsis* species. In the latter case involving isolates from tea, the metabolites were named after the *Pestalotiopsis* (pestalazines and pestalamides), but they are probably just metabolites of *A. luchuensis*, a species also found on tea (Hong *et al.* 2013). Similarly, strains of *Chaetomium globosum* (Wang *et al.* 2006) and *Microascus tardifaciens* (Fujimoto *et al.* 1999) were reported to produce a series of *Aspergillus* extrolites typical of species formerly classified in *Eurotium*, but were probably either misidentified or the cultures were mixed.

Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry fingerprinting (MALDI-TOF MS)

Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry fingerprinting (MALDI-TOF MS) is fast becoming an important tool for species identification in the medical field, having been successfully applied to bacteria (Hettick *et al.* 2006, Siegrist *et al.* 2007) and yeasts (Amiri-Eliasi & Fenselau 2001, Kolečka *et al.* 2013). The medical importance of various

Aspergillus species causing aspergillosis, most notably *A. fumigatus*, has led to a few studies testing MALDI-TOF as an identification tool. As with MALDI-TOF experiments on the closely related *Penicillium* (Welham *et al.* 2000, Hettick *et al.* 2008, Del Chierico *et al.* 2012, Chalupová *et al.* 2014), results seem promising (Bille *et al.* 2011, De Carolis *et al.* 2011, Iriart *et al.* 2012, Verwer *et al.* 2013). For example, De Carolis *et al.* (2011) showed that MALDI-TOF successfully distinguished between the closely related *A. fumigatus* and *A. lentulus*. In all of these studies, wide variation is observed in spectra of different strains of the same species, with Hettick *et al.* (2008) also reporting variation between duplicates of the same *Penicillium* strain. However, in most cases, spectra from the same species cluster together, meaning that the database should be expanded to include as many strains as possible to increase identification accuracy.

TAXONOMY

Following the phylogenetic study by Houbraken & Samson (2011), the type species of *Polypaecilum* and *Phialosimplex* were shown to be related to members of sections *Cremeri* and *Aspergillus*, placing those genera within *Aspergillus*. Varga *et al.* (2007a) showed that *Dichotomomyces*, which also has a *Polypaecilum*-like asexual state, is closely related to sections *Fumigati* and *Clavati*, and proposed the synonymy of this genus with *Aspergillus*.

The relationship of *Penicillium inflatum* with other members of the *Aspergillaceae* was studied by combining the *RPB2*, *Cct8* and *Tsr1* data sets (Fig. 4). Statistical support was measured by Maximum Likelihood (ML) analysis using the RAXML (randomised accelerated maximum likelihood) software (Stamatakis 2014) and by Bayesian tree inference (BI) analysis using MrBayes v3.1.2 (Ronquist & Huelsenbeck 2003). Prior to the analysis, the most suitable substitution model was determined using MrModeltest 2.3 (Nylander *et al.* 2004), utilising the Akaike Information Criterion (AIC). The phylogeny shows that *P. inflatum* belongs to *Aspergillus* section *Cremeri* (Gams *et al.* 1985; Fig. 4). This section (the *A. cremeus* species group of Raper & Fennell 1965) includes species with colonies in shades of yellowish brown to brown or grey green, biserial conidial heads and long conidiophores. Peterson (1995, 2000) studied section *Cremeri* in detail and transferred several species to this section based on molecular evidence, including *A. wentii* (from section *Wentii*), *A. dimorphicus* (from section *Circumdati*), *A. gorakhpurensis* and *A. pulvinus* (from section *Versicolores*). Later, Varga *et al.* (2000) also transferred *A. sepultus* to this section. Recently, Peterson (2008) found that *A. brunneouniseriatus* (previously assigned to section *Ornati*) also belongs to section *Cremeri*, although supported only by low bootstrap values and Bayesian posterior probabilities. The species assigned to this section are economically less important, with the exception of *A. wentii*, which is a source of enzymes, and frequently included in 'koji' (Raper & Fennell 1965, Lowe 1992).

When Stolk & Malla (1971) described *P. inflatum*, they speculated that the swollen apices of its conidiophores and strongly diverging metulae might suggest that the species belongs in *Aspergillus*. They decided to place it in *Penicillium* because of the lack of a foot-cell, its thin conidiophore walls and the fact that its metulae did not develop simultaneously. *Penicillium inflatum* was reported to produce sterigmatocystin (Rank *et al.* 2011),

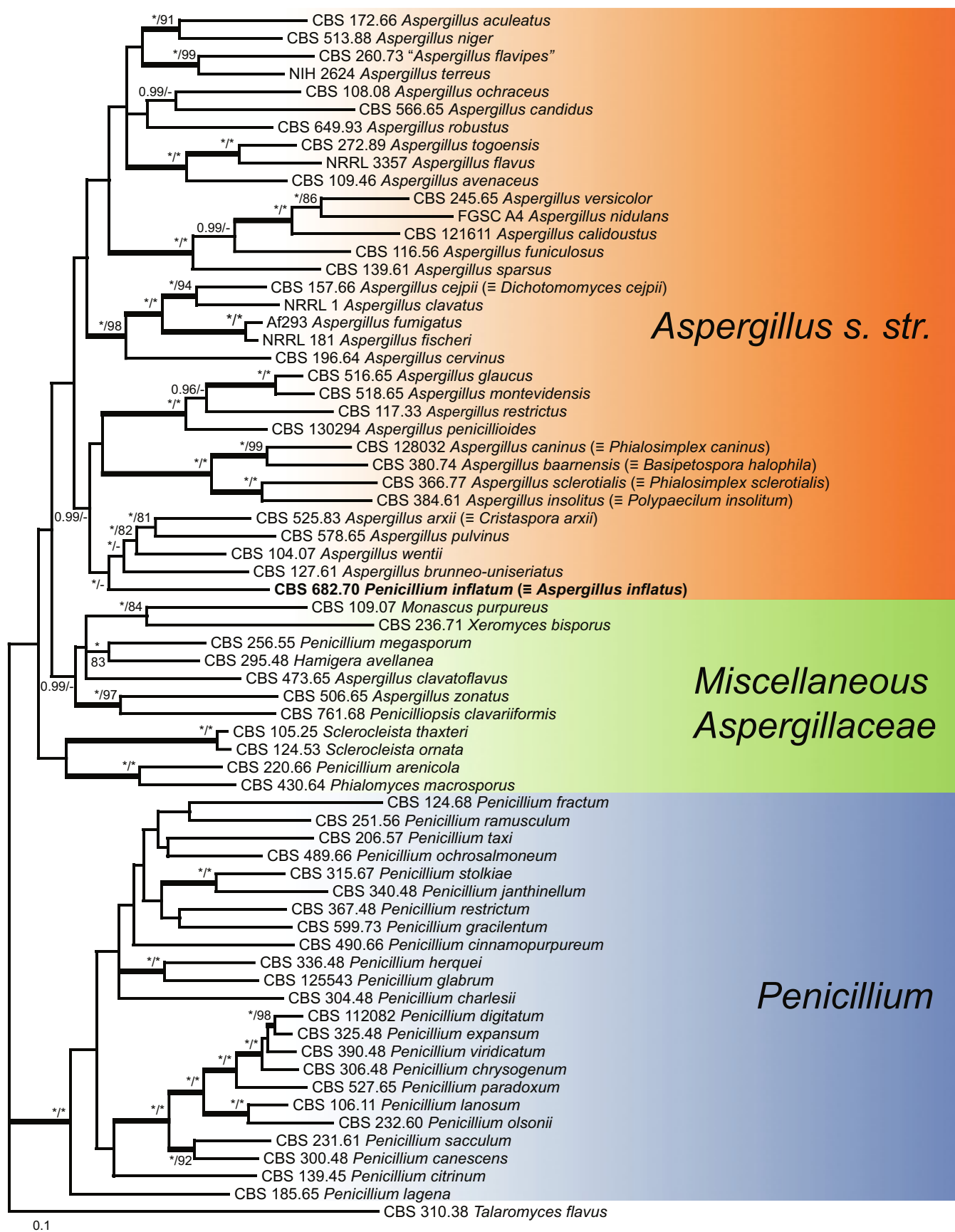


Fig. 4. Combined phylogeny of the *RPB2*, *Cct8* and *Tsr1* gene regions showing the phylogenetic position of *P. inflatum* (\equiv *A. inflatus*) in *Aspergillus* sect. *Cremeri*. The tree was rooted to *Talaromyces flavus*. Branches with bootstrap support above 80 % and/or posterior probability above 0.95 are given above thickened branches.

confirmed for all strains of *P. inflatum* in the present study, with three of the strains also producing patulin or its precursor 6-methylsalicylic acid. Patulin occurs in species in *Aspergillus*, *Penicillium* and *Byssosclamyces*, but sterigmatocystin is restricted

to species in four different sections in *Aspergillus* (*Ochraceorosei*, *Versicolores*, *Nidulantes* and *Flavi*) and has never been found in *Penicillium sensu stricto*. Chemotaxonomic evidence thus supports that *P. inflatum* should be transferred to *Aspergillus*.

Among the species formerly ascribed to *Phialosimplex*, *Polypaecilum* and *Basipetospora*, two of these are halophilic and like other halophilic species do not produce many extrolites (Frisvad 2005). No traceable extrolites were found in *Basipetospora halophila* and *Polypaecilum pisci*. *Phialosimplex chlamydosporus* did not produce any extrolites under the conditions tested, while *Phialosimplex sclerotialis* and *Polypaecilum insolitum* each produced only what appeared to be unique extrolites for those species, preventing any chemotaxonomic comparison with other *Aspergillus* species. However, *Phialosimplex caninus* produced asteric acid, erdin and sulochrin, extrolites found in *Aspergillus terreus* (Samson et al. 2011), *Penicillium glabrum* (as *P. frequentans*) (Mahmoodian & Stickings, 1964) and *P. estinogenum*.

Houbraken & Samson (2011) found that the type species of *Cristaspora*, *C. arxii*, formed a well-supported clade with members of section *Cremeri* (*A. pulvinus*, *A. wentii*, *A. brunneouniseriatus*) and that this clade is more closely related to members of the subgenus *Aspergillus* than to subgenus *Circumdati*. The transfer of *C. arxii* is therefore proposed below. *Cristaspora arxii* shares the production of rubratoxins together with *Aspergillus* (*Dichotomomyces*) *cejpai* (Varga et al. 2007a) and *Talaromyces purpogenus* (Yilmaz et al. 2012). Rubratoxins are not produced by species of *Penicillium*.

By including genera and species with morphological structures deviating from the typical aspergillum, the generic concept should be emended to the following polythetic description:

***Aspergillus* P. Micheli ex Haller, emended description**

Generic type: *Aspergillus glaucus* (L.) Link

Vegetative mycelium hyaline to brightly pigmented. Conidiophores (aspergillum) consisting of thick-walled basal cells (foot cell) producing stalks, usually aseptate and unbranched, terminating in inflated apex (vesicle) which can be globose, ellipsoidal to clavate; conidiophores in some species may be septate, lack a foot cell, lack a vesicle, or consisting of single conidiogenous cells with one to several loci. Conidiogenous cells phialidic, producing dry conidial chains borne directly on the vesicle (uniseriate) or on metulae (biseriate); in a few species, appearing to be annellidic or polyphialidic. Conidia greatly varying in colour, size, shape and ornamentation. Cleistothecia of various structures produced by some species with mostly a thin ascoma wall consisting of a single layer of hyphal networks, sometimes covered by layers of Hülle cells or sclerotium-like. Asci globose usually containing eight ascospores. Ascospores often lenticular, hyaline or coloured, varying in size, shape and ornamentation. Sclerotia or sclerotium-like structures regularly present in some species, varying in colour, size and shape, consisting of thick-walled cells, sometimes containing ascigerous structures. Hülle cells sometimes covering cleistothecia or occurring in compact masses in the mycelium, varying in shape and size, but mostly thick-walled and hyaline.

The following new combinations and new names are proposed:

Aspergillus arxii (Fort & Guarro) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809575.

Basionym: *Cristaspora arxii* Fort & Guarro, Mycologia 76: 1115. 1984.

Typus: CBS H-14047, culture ex-type CBS 525.83 = ATCC 52744 = FMR 416.

Aspergillus assulatus (S.B. Hong, Frisvad & Samson) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809576. *Basionym:* *Neosartorya assulata* S.B. Hong, Frisvad & Samson, Antonie van Leeuwenhoek 93: 95. 2008.

Typus: KACC 41691, culture ex-type KACC 41691 = IBT 27911.

Aspergillus astellatus (Fennell & Raper) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809577.

Basionym: *Aspergillus variegatus* var. *astellatus* Fennell & Raper, Mycologia 47: 81. 1955.

≡ *Emericella astellata* (Fennell & Raper) Y. Horie, Trans. Mycol. Soc. Japan 21: 491. 1980.

Typus: IMI 061455, culture ex-type CBS 134.55 = CBS 261.93 = NRRL 2396 = ATCC 16817 = IMI 61455 = IMI 61455ii = NRRL A-1634 = QM 1910 = WB 2396.

Aspergillus australensis (Samson, S.B. Hong & Varga) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809578. *Basionym:* *Neosartorya australensis* Samson, S.B. Hong & Varga, Stud. Mycol. 59: 174. 2007.

Typus: CBS 112.55, culture ex-type CBS 112.55 = NRRL 2392 = IMI 061450.

Aspergillus baarnensis Samson, Visagie & Houbraken, **nom. nov.** MycoBank MB809579.

Basionym: *Oospora halophila* J.F.H. Beyma, Zentralbl. Bakteriell. Parasitenk., Abt. 2 88: 134. 1933.

≡ *Basipetospora halophila* (J.F.H. Beyma) Pitt & A.D. Hocking, Mycotaxon 22: 198. 1985.

= *Scopulariopsis halophilica* Tubaki, Trans. Mycol. Soc. Japan 14: 367. 1973.

Typus: CBS 232.32, culture ex-type: CBS 232.32 = VKM F-204.

Etymology: Latin, *baarnensis*, named after the city of Baarn, the Netherlands, the original home of CBS where *Oospora halophila* was discovered.

Note: Non *Aspergillus halophilus* Sartory, R. Sartory & J. Mey., Ann. Mycol. 28: 362. 1930. Non *Aspergillus halophilicus* C.M. Chr. et al., Mycologia 51: 636. 1961. With the names *A. halophilus* and *A. halophilicus* already being occupied, the new name is proposed.

Aspergillus caninus (Sigler, Deanna A. Sutton, Gibas, Summerb. & Iwen) Houbraken, Tanney, Visagie & Samson, **comb. nov.** MycoBank MB809580.

Basionym: *Phialosimplex caninus* Sigler, Deanna A. Sutton, Gibas, Summerb. & Iwen, Med. Mycol. 48: 338. 2010.

Typus: UAMH 10337, culture ex-type CBS 128032 = UAMH 10337.

Aspergillus capsici (J.F.H. Beyma) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809581.

Basionym: *Scopulariopsis capsici* J.F.H. Beyma, Antonie van Leeuwenhoek 10: 50. 1945.

≡ *Polypaecilum capsici* (J.F.H. Beyma) G. Sm., Trans. Brit. Mycol. Soc. 44: 439. 1961.

Typus: CBS 176.44, culture ex-type CBS 176.44 = IMI 086564 = LSHB BB423 = QM 7962.

Aspergillus cejpaii (Milko) Samson, Varga, Visagie & Houbraken, **comb. nov.** MycoBank MB809582.

Basionym: *Talaromyces cejpaii* Milko, Novosti Sist. Nizsh. Rast. 1: 208. 1964.

≡ *Dichotomomyces cejpaii* (Milko) D.B. Scott, Trans. Brit. Mycol. Soc. 47: 428. 1970.

Typus: CBS H-7011, culture ex-type CBS 157.66.

Aspergillus chinensis Samson, Visagie & Houbraken, **nom. nov.** MycoBank MB809583.

Basionym: *Emericella appendiculata* Y. Horie & D.M. Li, Mycoscience 39: 161. 1998.

Typus: CBM FA-865, culture ex-type CBS 128791 = IFM 54282 = CBM FA-865.

Etymology: Latin, *chinensis*, named in reference to the type originating from China.

Note: Non *Aspergillus appendiculatus* Blaser, Sydowia 28: 38. 1975. The name *A. appendiculatus* is already occupied and therefore the new name is proposed.

Aspergillus chlamydosporus (Gené & Guarro) Houbraken, Tanney, Visagie & Samson, **comb. nov.** MycoBank MB809584.

Basionym: *Sagenomella chlamydospora* Gené & Guarro, J. Clin. Microbiol. 41: 1723. 2003.

≡ *Phialosimplex chlamydosporus* (Gené & Guarro) Sigler, Med. Mycol. 48: 341. 2010.

Typus: IMI 387422, culture ex-type CBS 109945 = IMI 387422 = FMR 7371.

Aspergillus delacroixii Samson, Visagie & Houbraken, **nom. nov.** MycoBank MB809585.

Basionym: *Aspergillus nidulans* var. *echinulatus* Fennell & Raper, Mycologia 47: 79. 1955.

≡ *Emericella nidulans* var. *echinulata* (Fennell & Raper) Godeas, Mycopathol. Mycol. Appl. 46: 193. 1972.

≡ *Emericella echinulata* (Fennell & Raper) Y. Horie, Trans. Mycol. Soc. Japan 21: 492. 1980.

Typus: IMI 061454, culture ex-type CBS 120.55 = NRRL 2395 = ATCC 16825 = IMI 061454 = LCP 84.2557 = QM 1909 = WB 2395.

Etymology: Latin, *delacroixii*, named after Edouard Georges Delacroix (1858–1907).

Note: Non *Aspergillus echinulatus* (Delacr.) Thom & Church, The Aspergilli: 107. 1926. The name *A. echinulatus* is already occupied and therefore the new name is proposed.

Aspergillus denticulatus (Samson, S.B. Hong & Frisvad) Samson, S.B. Hong, Visagie & Houbraken, **comb. nov.** MycoBank MB809586.

Basionym: *Neosartorya denticulata* Samson, S.B. Hong & Frisvad, Antonie van Leeuwenhoek 93: 95. 2008.

Typus: CBS 652.73, culture ex-type CBS 652.73 = KACC 41183.

Aspergillus desertorum (Samson & Mouch.) Samson, Visagie & Houbraken, **comb. nov.** MycoBank MB809587.

Basionym: *Emericella desertorum* Samson & Mouch., Antonie van Leeuwenhoek 40: 121. 1974.

Typus: CBS H-7045, culture ex-type CBS 653.73 = NRRL 5921 = IMI 343076.

Aspergillus ferenczii (Varga & Samson) Samson, Varga, Visagie & Houbraken, **comb. nov.** MycoBank MB809588.

Basionym: *Neosartorya ferenczii* Varga & Samson, Stud. Mycol. 59: 178. 2007.

Typus: CBS 121594, culture ex-type CBS 121594 = NRRL 4179 = IBT 27813 = DTO24F2.

Aspergillus galapagensis (Frisvad, S.B. Hong & Samson) Samson, Frisvad & Houbraken, **comb. nov.** MycoBank MB809589.

Basionym: *Neosartorya galapagensis* Frisvad, S.B. Hong & Samson, Antonie van Leeuwenhoek 93: 96. 2008.

Typus: CBS 117522, culture ex-type CBS 117522 = IBT 16756 = KACC 41935 = DTO3H4.

Aspergillus inflatus (Stolk & Malla) Samson, Frisvad, Varga, Visagie & Houbraken, **comb. nov.** MycoBank MB809590. Fig. 5.

Basionym: *Penicillium inflatum* Stolk & Malla, Persoonia 6: 197. 1971.

Typus: CBS H-7500, culture ex-type CBS 682.70 = FRR 1549 = IMI 191498.

Aspergillus insolitus (G. Sm.) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809591.

Basionym: *Polypaecilum insolitum* G. Sm., Trans. Brit. Mycol. Soc. 44: 437. 1961.

Typus: CBS 384.61, culture ex-type CBS 384.61 = ATCC 18164 = IFO 8788 = IMI 075202 = LSHB BB414 = MUCL 3078 = QM 7961.

Aspergillus jaipurensis Samson, Visagie & Houbraken, **nom. nov.** MycoBank MB809592.

Basionym: *Emericella indica* Stchigel & Guarro, Mycol. Res. 103: 1059. 1999.

Typus: IMI 378525, culture ex-type IMI 378525.

Etymology: Latin, *jaipurensis*, named after the city Jaipur in India, the origin of the type strain.

Note: Non *Aspergillus indicus* B.S. Mehrotra & Agnihotri, Mycologia 54: 403. 1963. The name *A. indicus* is already occupied and therefore the new name is proposed.

Aspergillus papuensis (Samson, S.B. Hong & Varga) Samson, S.B. Hong & Varga, **comb. nov.** MycoBank MB809593.

Basionym: *Neosartorya papuensis* Samson, S.B. Hong & Varga, Stud. Mycol. 59: 190. 2007.

Typus: CBS H-6277, culture ex-type CBS 841.96 = IBT 27801.

Aspergillus pisci (A.D. Hocking & Pitt) Houbraken, Visagie & Samson, **comb. nov.** MycoBank MB809594.

Basionym: *Polypaecilum pisci* A.D. Hocking & Pitt, [as '*pisce*'] Mycotaxon 22: 200. 1985.

Typus: FRR 2732, culture ex-type FRR 2732 = ATCC 56982 = IMI 288726.

Aspergillus pluriseminatus (Stchigel & Guarro) Samson, Visagie & Houbraken, **comb. nov.** MycoBank MB809595.

Basionym: *Emericella pluriseminata* Stchigel & Guarro, Mycologia 89: 937. 1997.

Typus: FMR 5588 (isotype IMI 370867), culture ex-type CBS 100523 = FMR 5588 = IMI 370867.



Fig. 5. *Aspergillus inflatus*. A. Colonies on CYA. B. Colonies on MEA. C. Colonies on CREA. D–H. Conidiophores. I. Conidia. Scale bars: D–I = 10 µm.

Aspergillus sclerotialis (W. Gams & Breton) Houbraken, Tanney, Visagie & Samson, **comb. nov.** MycoBank MB809596. *Basionym*: *Sagenomella sclerotialis* W. Gams & Breton, Persoonia 10: 109. 1978.

≡ *Phialosimplex sclerotialis* (W. Gams & Breton) Sigler, Med. Mycol. 48: 341. 2010.

Typus: CBS 366.77, culture ex-type CBS 366.77 = IAM 14794.

Aspergillus shendawei (Yaguchi, Abliz & Y. Horie) Samson, Visagie & Houbraken, **comb. nov.** MycoBank MB809597.

Basionym: *Neosartorya shendawei* Yaguchi, Abliz & Y. Horie, Mycoscience 51: 260. 2010.

Typus: CBM FA-0958, culture ex-type IFM 57611.

Aspergillus similis (Y. Horie, Udagawa, Abdullah & Al-Bader) Samson, Visagie & Houbraken, **comb. nov.** MycoBank MB809598.

Basionym: *Emericella similis* Y. Horie, Udagawa, Abdullah & Al-Bader, Trans. Mycol. Soc. Japan 31: 425. 1990.

Typus: CBM 10007, culture ex-type CBS 293.93 = NHL 3000.

Aspergillus solicola Samson, Visagie & Houbraken, **nom. nov.** MycoBank MB809599.

Basionym: *Neosartorya warcupii* Peterson, Varga & Samson, Stud. Mycol. 59: 201. 2007.

Typus: NRRL 35723, culture ex-type NRRL 35723.

Etymology: Latin, *solicola*, meaning soil inhabitant, in reference to the type strain that was isolated from soil.

Note: Non *Aspergillus warcupii* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 50. 1985. The name *A. warcupii* is already occupied and therefore the new name is proposed.

Aspergillus tsunodae (Yaguchi, Abliz & Y. Horie) Samson, Visagie & Houbraken, **comb. nov.** MycoBank MB809600.

Basionym: *Neosartorya tsunodae* Yaguchi, Abliz & Y. Horie, Mycoscience 51: 261. 2010.

Typus: CBM FA-0950, culture ex-type IFM 57609 = NBRC 106416.

Proposed list of accepted *Aspergillus* names

The following list includes species accepted in the genus *Aspergillus* and is updated from Pitt & Samson (1993) and Pitt *et al.* (2000). Noticeable changes from the previous lists are the incorporation of *Aspergillus* names for species previously accepted in the associated teleomorphic genera, as well as species previously classified in *Cristaspora*, *Dichotomomyces*, *Basipetospora*, *Phialosimplex* and *Polypaecilum* as well as *Penicillium inflatum*. The nomenclatural list includes MycoBank numbers, collection numbers of type and ex-type cultures and GenBank accession numbers to ITS barcodes and alternative identification markers *BenA*, *CaM* and *RPB2*. Similar lists are published for *Penicillium* (Visagie *et al.* 2014a) and *Talaromyces* (Yilmaz *et al.* 2014).

A considerable amount of time and effort was spent on having the list as complete as possible. However, we acknowledge that there might be some mistakes in this list. As such, we gratefully accept any comments on missing names, errors, new data that has become available, or on methods to make the list more

functional. As the taxonomy keeps evolving in fungi, this list will be kept up to date on <http://www.aspergilluspenicillium.org> from where comments can be sent to curators of the list. The website also lists currently considered synonym names and is not included in the list below.

Aspergillus P. Micheli ex Haller, Hist. Stirp. Helv.: 113. 1768. MycoBank MB7248.

≡ *Aspergillus* P. Micheli, Nov. Pl. Gen.: 212, t. 92.1729. [MB39019]. anamorphic synonym.

= *Eurotium* Link, Mag. Ges. Naturf. Freunde Berlin 3: 31, t. 2:44. 1809. [MB1942]. teleomorphic synonym.

= *Briarea* Corda, Deutschl. Fl. (Sturm), Abt. 3, Pilze Deutschl. 2–6: 11. 1831, *fide* Raper & Fennell 1965. [MB7448]. anamorphic synonym.

?= *Cladaspergillus* Ritgen, Schr. Marb. Ges.: 89. 1831, *fide* Saccardo 1901. [MB7673]. anamorphic synonym.

?= *Sceptromyces* Corda, Deutschl. Fl. (Sturm), Abt. 3, Pilze Deutschl. 3–11: 7. 1831, *fide* Engelke 1902 (q.v.). [MB9797]. anamorphic synonym.

?= *Rhodocephalus* Corda, Icon. Fung. (Prague) 1: 21. 1837, see Samson *et al.* 2011. [MB9736]. anamorphic synonym.

?= *Acosporium* Corda, Icon. Fung. (Prague) 3: 11. 1839, *fide* Hughes 1958, Seifert *et al.* 2011. [MB7022]. anamorphic synonym.

= *Moniliger* Letell. 1839, *fide* Seifert, Gams, based on the protologue. [MB1839]. anamorphic synonym.

?= *Sphaeromyces* Mont., Ann. Sci. Nat., Bot. 4: 365. 1845, *fide* Carmichael *et al.* 1980. [MB9985]. anamorphic synonym.

= *Emericella* Berk., Intr. Crypt. Bot. (London): 340. 1857. [MB1772]. teleomorphic synonym.

= *Sterigmatocystis* C.E. Cramer, Vierteljahrsschr. Naturforsch. Ges. Zürich 4: 326. 1859, *fide* Clements & Shear 1931, Raper & Fennell 1965 (q.v.). [MB 10091]. anamorphic synonym.

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- Aspergillus brunneus*** Delacr., Bull. Soc. Mycol. Fr. 9: 185. 1893 = *Eurotium echinulatum* Delacr., Bull. Soc. Mycol. Fr. 9: 266. 1893. [MB204832]. — Herb.: IMI 211378. Ex-type: CBS 112.26 = CBS 524.65 = NRRL 131 = NRRL 134 = ATCC 1021 = IFO 5862 = IMI 211378 = QM 7406 = Thom 4481 = Thom 5633.4 = WB 131. ITS barcode: EF652060. (Alternative markers: *BenA* = EF651907; *CaM* = EF651998; *RPB2* = EF651939).
- Aspergillus caatingensis*** Y. Horie *et al.*, Mycoscience 55: 84. 2014. [MB801323]. — Herb.: IFM 61335H. Ex-type: IFM 61335. ITS barcode: n.a. (Alternative markers: *BenA* = AB743855; *CaM* = AB743861; *RPB2* = n.a.).
- Aspergillus caelatus*** B.W. Horn, Mycotaxon 61: 186. 1997. [MB436955]. — Herb.: BPI 737601. Ex-type: CBS 763.97 = NRRL 25528 = ATCC 201128. ITS barcode: AF004930. (Alternative markers: *BenA* = EF661470; *CaM* = EF661522; *RPB2* = EF661436).
- Aspergillus caesiellus*** Saito, J. Coll. Sci. Imp. Univ. Tokyo 18: 49. 1904. [MB205025]. — Herb.: IMI 172278. Ex-type: CBS 470.65 = NRRL 5061 = ATCC 11905 = IFO 4882 = IMI 172278 = WB 5061. ITS barcode: EF652044. (Alternative markers: *BenA* = EF651884; *CaM* = EF652030; *RPB2* = EF651981).
- Aspergillus caespitosus*** Raper & Thom, Mycologia 36: 563. 1944. [MB284298]. — Herb.: IMI 16034ii. Ex-type: CBS 103.45 = NRRL 1929 = ATCC 11256 = IMI 16034 = MUCL 13587 = NCTC 6972 = NCTC 6973 = QM 7399 = WB 1929. ITS barcode: EF652428. (Alternative markers: *BenA* = EF652252; *CaM* = EF652340; *RPB2* = EF652164).
- Aspergillus calidoustus*** Varga, Houbraken & Samson, Eukaryot. Cell 7: 636. 2008. [MB504846]. — Herb.: unknown. Ex-type: CBS 121601. ITS barcode: HE616558. (Alternative markers: *BenA* = FJ624456; *CaM* = HE616559; *RPB2* = n.a.).
- Aspergillus californicus*** Frisvad, Varga & Samson, Stud. Mycol. 69: 91. 2011. [MB560400]. — Herb.: CBS H-20635. Ex-type: CBS 123895 = IBT 16748.

- ITS barcode: FJ531153. (Alternative markers: *BenA* = FJ531180; *CaM* = FJ531128; *RPB2* = n.a.).
- Aspergillus campestris*** M. Chr., Mycologia 74: 212. 1982. [MB110495]. — Herb.: NY ST 2–3–1. Ex-type: CBS 348.81 = NRRL 13001 = ATCC 44563 = IMI 259099. ITS barcode: EF669577. (Alternative markers: *BenA* = EU014091; *CaM* = EF669535; *RPB2* = EF669619).
- Aspergillus candidus*** Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. Fr. [MB204868]. — Herb.: CBS 566.65. Ex-type: CBS 566.65 = NRRL 303 = ATCC 1002 = IMI 16264 = IMI 91889 = LSHBA c.27 = NCTC 595 = QM 1995 = Thom 106 = WB 303. ITS barcode: EF669592. (Alternative markers: *BenA* = EU014089; *CaM* = EF669550; *RPB2* = EF669634). Note: CBS 567.65 was incorrectly published to represent NRRL 303 (Samson & Gams 1985) and was considered the neotype of *A. candidus*. CBS 566.65 represents NRRL 303 and is the correct ex-neotype of the species.
- Aspergillus caninus*** (Sigler et al.) Houbaken et al., published here ≡ *Phialosimplex caninus* Sigler et al., Med. Mycol. 48: 338. 2010. [MB809580]. — Herb.: UAMH 10337. Ex-type: CBS 128032 = UAMH 10337. ITS barcode: GQ169315. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = JN121445).
- Aspergillus capensis*** Visagie, Hirooka & Samson, Stud. Mycol. 78: 105. 2014. [MB809193]. — Herb.: CBS H-21810. Ex-type: CBS 138188 = DTO 179E6. ITS barcode: KJ775550. (Alternative markers: *BenA* = KJ775072; *CaM* = KJ775279; *RPB2* = n.a.).
- Aspergillus capsici*** (J.F.H. Beyma) Houbaken, Visagie & Samson, published here ≡ *Scopulariopsis capsici* J.F.H. Beyma, Antonie van Leeuwenhoek 10: 50. 1945 ≡ *Polypaecilum capsici* (J.F.H. Beyma) G. Sm., Trans. Brit. Mycol. Soc. 44: 439. 1961. [MB809581]. — Herb.: CBS 176.44. Ex-type: CBS 176.44 = IMI 086564 = LSHB BB423 = QM 7962. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus carbonarius*** (Bainier) Thom, J. Agric. Res. 7: 12. 1916 ≡ *Sterigmatocystis carbonaria* Bainier, Bull. Soc. Bot. Fr. 27: 27. 1880. [MB100545]. — Herb.: CBS 556.65. Ex-type: CBS 111.26 = NRRL 369 = ATCC 1025 = IMI 16136 = LSHBA c.11 = NCTC 1325 = NRRL 1987 = QM 331 = Thom 4030.1 = WB 369. ITS barcode: EF661204. (Alternative markers: *BenA* = EF661099; *CaM* = EF661167; *RPB2* = EF661068).
- Aspergillus carlsbadensis*** Frisvad, Varga & Samson, Stud. Mycol. 69: 92. 2011. [MB560399]. — Herb.: CBS H-30634. Ex-type: CBS 123894 = IBT 14493. ITS barcode: FJ531151. (Alternative markers: *BenA* = FJ531179; *CaM* = FJ531126; *RPB2* = n.a.).
- Aspergillus carneus*** Blochwitz, Ann. Mycol. 31: 81. 1933. [MB259903]. — Herb.: IMI 135818. Ex-type: CBS 494.65 = NRRL 527 = ATCC 16798 = IMI 135818 = QM 7401 = Thom 5740.4 = WB 527. ITS barcode: EF669611. (Alternative markers: *BenA* = EF669529; *CaM* = EF669569; *RPB2* = EF669653).
- Aspergillus cavernicola*** Lőrinczi, Contr. Bot. Cluj. 341. 1969. [MB326617]. — Herb.: CBS 117.76. Ex-type: CBS117.76 = NRRL6327. ITS barcode: EF652508. (Alternative markers: *BenA* = EF652332; *CaM* = EF652420; *RPB2* = EF652244).
- Aspergillus cejpai*** (Milko) Samson, Varga, Visagie & Houbaken, published here ≡ *Talaromyces cejpai* Milko, Nov. sist. Niz. Rast. 1: 208. 1964 ≡ *Dichotomomyces cejpai* (Milko) D.B. Scott, Trans. Brit. Mycol. Soc. 55: 314. 1970. [MB809582]. — Herb.: CBS H-7011. Ex-type: CBS 157.66. ITS barcode: n.a. (Alternative markers: *BenA* = EU076314; *CaM* = n.a.; *RPB2* = JN121447).
- Aspergillus cervinus*** Massee, Bull. Misc. Inform. Kew 1914: 158. 1914. [MB211549]. — Herb.: WIS WISC WT 540. Ex-type: CBS 537.65 = NRRL 5025 = ATCC 16915 = IMI 126542 = QM 8875 = WB 5025. ITS barcode: EF661268. (Alternative markers: *BenA* = EF661251; *CaM* = EF661261; *RPB2* = EF661229).
- Aspergillus chevalieri*** (L. Mangin) Thom & Church, The Aspergilli: 111. 1926 ≡ *Eurotium chevalieri* L. Mangin, Annls Sci. Nat., Bot., sér. 9 10: 361. 1910. [MB292839]. — Herb.: IMI 211382. Ex-type: CBS 522.65 = NRRL 78 = ATCC 16443 = IMI 211382 = NRRL A-7803 = Thom 4125.3 = WB 78. ITS barcode: EF652068. (Alternative markers: *BenA* = EF651911; *CaM* = EF652002; *RPB2* = EF651954).
- Aspergillus chinensis*** Samson, Visagie & Houbaken, published here ≡ *Emericella appendiculata* Y. Horie & D.M. Li, Mycoscience 39: 161. 1998. [MB809583]. — Herb.: CBM FA-865. Ex-type: CBS 128791 = IFM 54282 = CBM FA-865. ITS barcode: AB249003. (Alternative markers: *BenA* = AB248345; *CaM* = AB476806; *RPB2* = n.a.).
- Aspergillus chlamydosporus*** (Gené & Guarro) Houbaken et al., published here ≡ *Sagenomella chlamydospora* Gené & Guarro, J. Clin. Microbiol. 41: 1723. 2003 ≡ *Phialosimplex chlamydosporus* (Gené & Guarro) Sigler, Med. Mycol. 48: 341. 2010. [MB809584]. — Herb.: IMI 387422. Ex-type: CBS 109945 = IMI 387422 = FMR 7371. ITS barcode: AJ519984. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = JN121425).
- Aspergillus chrysellus*** Kwon-Chung & Fennell, Gen. *Aspergillus*: 424. 1965 ≡ *Chaetosartorya chrysella* (Kwon-Chung & Fennell) Subram., Curr. Sci. 41: 761. 1972 ≡ *Harpezomyces chrysellus* (Kwon-Chung & Fennell) Malloch & Cain, Can. J. Bot. 50: 2619. 1973 ≡ *Aspergillus chryseides* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 36. 1985. [MB326618]. — Herb.: IMI 238612. Ex-type: CBS 472.65 = NRRL 5084 = ATCC 16852 = IMI 238612 = IMI 238612ii = QM 8876 = WB 5084. ITS barcode: EF652155. (Alternative markers: *BenA* = EF652109; *CaM* = EF652136; *RPB2* = EF652090).
- Aspergillus cibarius*** S.B. Hong & Samson, J. Microbiol. 50: 713. 2012. [MB800861]. — Herb.: KACC 46346. Ex-type: KACC 46346. ITS barcode: JQ918177. (Alternative markers: *BenA* = JQ918180; *CaM* = JQ918183; *RPB2* = JQ918186).
- Aspergillus citrisporus*** Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math. Naturwiss. Cl., Abt.1, 111: 1036. 1902 = *Neosartorya citrispora* Malloch & Cain, Can. J. Bot. 50: 2620. 1973. [MB211485]. — Herb.: ex caterpillar dung, Kittery Point, R. Thaxter (FH). Ex-type: NRRL 4225 and NRRL 4735 (representative strains). ITS barcode: EF669702. (Alternative markers: *BenA* = EF669674; *CaM* = EF669688; *RPB2* = EF669661).
- Aspergillus clavatonanicus*** Bat. et al., Anais Fac. Med. Univ. Recife 15: 197. 1955. [MB292840]. — Herb.: IMI 235352. Ex-type: CBS 474.65 = NRRL 4741 = ATCC 12413 = DMUR 532 = IMI 235352 = JCM 10183 = QM 7059 = WB 4741. ITS barcode: EF669986. (Alternative markers: *BenA* = EF669842; *CaM* = EF669912; *RPB2* = EF669773).
- Aspergillus clavatus*** Desm., Ann. Sci. Nat., Bot., ser. 2, 2: 71. 1834. [MB211530]. — Herb.: IMI 15949. Ex-type: CBS 513.65 = NRRL 1 = ATCC 1007 = ATCC 9598 = ATCC 9602 = CECT2674 = DSM 816 = IMI 15949 = LSHBA c.86 = LSHBA c.95 = MIT213 = NCTC 3887 = NCTC 9 = NCTC 978 = NRRL 1656 = QM 1276 = QM 7404 = Thom 107 = WB 1. ITS barcode: EF669942. (Alternative markers: *BenA* = EF669802; *CaM* = EF669871; *RPB2* = EF669730).
- Aspergillus conicus*** Blochwitz, Ann. Mycol. 12: 38. 1914. [MB120214]. — Herb.: IMI 172281. Ex-type: CBS 475.65 = NRRL 149 = ATCC 16908 = IMI 172281 = QM 7405 = Thom 4733.701 = WB 149. ITS barcode: EF652039. (Alternative markers: *BenA* = EF651881; *CaM* = EF652033; *RPB2* = EF651975).
- Aspergillus conjunctus*** Kwon-Chung & Fennell, Gen. *Aspergillus*: 552. 1965. [MB326620]. — Herb.: IMI 135421. Ex-type: CBS 476.65 = NRRL 5080 = ATCC 16796 = IMI 135421 = QM 8878 = WB 5080. ITS barcode: EF661179. (Alternative markers: *BenA* = EF661111; *CaM* = EF661133; *RPB2* = EF661042).
- Aspergillus conversis*** Hubka & A. Nováková, Fungal Divers. 64: 262. 2014. [MB803935]. — Herb.: PRM 860541. Ex-type: CBS 135457 = NRRL 62496 = CCF 4190 = CMF ISB 2151 = IFM 60857. ITS barcode: HF937385. (Alternative markers: *BenA* = HF933363; *CaM* = HF933387; *RPB2* = HF937379).
- Aspergillus coreiiformis*** Bartoli & Maggi, Trans. Brit. Mycol. Soc. 71: 386. 1979. [MB309214]. — Herb.: RO 102 S. Ex-type: CBS 553.77 = NRRL 13603 = ATCC 38576 = IMI 223069 = NRRL 13756. ITS barcode: EF661544. (Alternative markers: *BenA* = EU014104; *CaM* = EU014112; *RPB2* = EU021623).
- Aspergillus corrugatus*** Udagawa & Y. Horie, Mycotaxon 4: 535. 1976 ≡ *Emericella corrugata* Udagawa & Y. Horie, Mycotaxon 4: 535. 1976. [MB309216]. — Herb.: NHL 2763. Ex-type: CBS 191.77 = NHL 2763. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus costaricensis*** Samson & Frisvad, Stud. Mycol. 50: 52. 2004. [MB500007]. — Herb.: CBS H-13437. Ex-type: CBS 115574 = IBT 23401 = CECT 20579 = ITEM 7555. ITS barcode: DQ900602. (Alternative markers: *BenA* = FJ629277; *CaM* = FN594545; *RPB2* = HE984361).
- Aspergillus costiformis*** H.Z. Kong & Z.T. Qi, Acta Mycol. Sin. 14: 10. 1995 ≡ *Eurotium costiforme* H.Z. Kong & Z.T. Qi, Acta Mycol. Sin. 14: 10. 1995. [MB363444]. — Herb.: HMAS 62766. Ex-type: CBS 101749 = AS 3.4664. ITS barcode: HE615136. (Alternative markers: *BenA* = HE801338; *CaM* = HE801320; *RPB2* = HE801309).
- Aspergillus creber*** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 69. 2012. [MB800598]. — Herb.: BPI 800912. Ex-type: NRRL 58592. ITS barcode: JQ301889. (Alternative markers: *BenA* = JN853980; *CaM* = JN854043; *RPB2* = JN853832).
- Aspergillus cremeus*** Kwon-Chung & Fennell, Gen. *Aspergillus*: 418. 1965 ≡ *Chaetosartorya cremea* (Kwon-Chung & Fennell) Subram., Curr. Sci. 41:

761. 1972 = *Harpezomyces cremeus* (Kwon-Chung & Fennell) Malloch & Cain, Can. J. Bot. 50: 2620. 1973 = *Aspergillus cremeoflavus* Samson & W. Gams, Adv. *Penicillium* *Aspergillus* Syst.: 37. 1985. [MB326621]. — Herb.: IMI 123749ii. Ex-type: CBS 477.65 = NRRL 5081 = ATCC 16857 = IMI 123749 = QM 8879 = QM 9191 = WB 5081. ITS barcode: EF652149. (Alternative markers: *BenA* = EF652120; *CaM* = EF652125; *RPB2* = EF652101).
- Aspergillus cretensis*** Frisvad & Samson, Stud. Mycol. 50: 33. 2004. [MB500002]. — Herb.: CBS H-13446. Ex-type: CBS 112802 = NRRL 35672 = IBT 17505. ITS barcode: FJ491572. (Alternative markers: *BenA* = AY819977; *CaM* = FJ491534; *RPB2* = EF661311).
- Aspergillus cristatus*** Raper & Fennell, Gen. *Aspergillus*: 169. 1965 = *Eurotium cristatum* (Raper & Fennell) Malloch & Cain, Can. J. Bot. 50: 64. 1972. [MB326622]. — Herb.: IMI 172278. Ex-type: CBS 123.53 = NRRL 4222 = ATCC 16468 = IMI 172280 = MUCL 15644 = WB 4222. ITS barcode: EF652078. (Alternative markers: *BenA* = EF651914; *CaM* = EF652001; *RPB2* = EF651957).
- Aspergillus crustosus*** Raper & Fennell, Gen. *Aspergillus*: 532. 1965. [MB326623]. — Herb.: IMI 135819. Ex-type: CBS 478.65 = NRRL 4988 = ATCC 16806 = IMI 135819 = NRRL A-3254 = QM 8910 = WB 4988. ITS barcode: EF652489. (Alternative markers: *BenA* = EF652313; *CaM* = EF652401; *RPB2* = EF652225).
- Aspergillus cumulatus*** D.H. Kim & S.B. Hong, J. Microbiol. Biotechnol. 24: 335. 2014. [MB807118]. — Herb.: KACC 47316. Ex-type: KACC 47316. ITS barcode: KF928303. (Alternative markers: *BenA* = KF928297; *CaM* = KF928300; *RPB2* = KF928294).
- Aspergillus cvjetkovicii*** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 69. 2012. [MB800599]. — Herb.: BPI 880909. Ex-type: NRRL 227. ITS barcode: EF652440. (Alternative markers: *BenA* = EF652264; *CaM* = EF652352; *RPB2* = EF652176).
- Aspergillus deflectus*** Fennell & Raper, Mycologia 47: 83. 1955. [MB292841]. — Herb.: IMI 61448. Ex-type: CBS 109.55 = NRRL 2206 = ATCC 16807 = IMI 61448 = NRRL A-2700A = QM 1904 = UC4638 = WB 2206. ITS barcode: EF652437. (Alternative markers: *BenA* = EF652261; *CaM* = EF652349; *RPB2* = EF652173).
- Aspergillus delacroixii*** Samson, Visagie & Houbraken, published here = *Aspergillus nidulans* var. *echinulatus* Fennell & Raper, Mycologia 47: 79. 1955 = *Emericella echinulata* (Fennell & Raper) Y. Horie, Trans. Mycol. Soc. Japan 21: 492. 1980. [MB809585]. — Herb.: IMI 061454. Ex-type: CBS 120.55 = NRRL 2395 = ATCC 16825 = IMI 061454 = LCP 84.2557 = QM 1909 = WB 2395. ITS barcode: EF652445. (Alternative markers: *BenA* = EF652269; *CaM* = EF652357; *RPB2* = EF652181).
- Aspergillus delicatus*** H.Z. Kong, Mycotaxon 62: 429. 1997 = *Neosartorya delicata* H.Z. Kong, Mycotaxon 62: 429. 1997. [MB437509]. — Herb.: HMAS 71159. Ex-type: CBS 101754 = AS 3.4697. ITS barcode: n.a. (Alternative markers: *BenA* = DQ114124; *CaM* = DQ114132; *RPB2* = n.a.).
- Aspergillus denticulatus*** (Samson, S.B. Hong & Frisvad) Samson *et al.*, published here = *Neosartorya denticulata* Samson, S.B. Hong & Frisvad, Antonie van Leeuwenhoek 93: 95. 2008. [MB809586]. — Herb.: CBS 652.73. Ex-type: CBS 652.73 = KACC 41183. ITS barcode: n.a. (Alternative markers: *BenA* = DQ114125; *CaM* = DQ114133; *RPB2* = n.a.).
- Aspergillus desertorum*** (Samson & Mouch) Samson, Visagie & Houbraken, published here = *Emericella desertorum* Samson & Mouch., Antonie van Leeuwenhoek 40: 121. 1974. [MB809587]. — Herb.: CBS H-7045. Ex-type: CBS 653.73 = NRRL 5921 = IMI 343076. ITS barcode: EF652505. (Alternative markers: *BenA* = EF652329; *CaM* = EF652417; *RPB2* = EF652241).
- Aspergillus dimorphicus*** B.S. Mehrotra & R. Prasad, Trans. Brit. Mycol. Soc. 52: 331. 1969. [MB326625]. — Herb.: IMI 131553. Ex-type: CBS 649.74 = NRRL 3650 = IMI 131553 = QM 9190. ITS barcode: EF652154. (Alternative markers: *BenA* = EF652111; *CaM* = EF652135; *RPB2* = EF652096).
- Aspergillus discophorus*** Samson, Zalar & Frisvad, Mycologia 100: 787. 2008 = *Emericella discophora* Samson, Zalar & Frisvad, Mycologia 100: 787. 2008. [MB507360]. — Herb.: CBS H-19889. Ex-type: CBS 469.88 = IBT 21910 = IMI 328717. ITS barcode: EU448272. (Alternative markers: *BenA* = AY339999; *CaM* = EU443970; *RPB2* = n.a.).
- Aspergillus diversus*** Raper & Fennell, Gen. *Aspergillus*: 437. 1965. [MB326626]. — Herb.: IMI 232882. Ex-type: CBS 480.65 = NRRL 5074 = ATCC 16849 = IMI 232882 = QM 8882 = WB 5074. ITS barcode: EF661213. (Alternative markers: *BenA* = EF661114; *CaM* = EF661128; *RPB2* = EF661034).
- Aspergillus duricaulis*** Raper & Fennell, Gen. *Aspergillus*: 249. 1965. [MB326627]. — Herb.: IMI 172282. Ex-type: CBS 481.65 = NRRL 4021 = ATCC 16900 = IMI 172282 = IMI 367413 = NRRL A-5509 = QM 8884 = WB 4021. ITS barcode: EF669971. (Alternative markers: *BenA* = EF669827; *CaM* = EF669897; *RPB2* = EF669758).
- Aspergillus eburneocreus*** Sappa, Allionia 2: 87. 1954. [MB292842]. — Herb.: TMI 69856. Ex-type: CBS 130.54 = NRRL 4773 = ATCC 16802 = IMI 69856 = MUCL 13588 = QM 1949 = WB 4773. ITS barcode: EF652476. (Alternative markers: *BenA* = EF652300; *CaM* = EF652388; *RPB2* = EF652212).
- Aspergillus egyptiacus*** Moub. & Mustafa, Egypt. J. Bot. 15: 153. 1972. [MB344341]. — Herb.: IMI 141415. Ex-type: CBS 656.73 = NRRL 5920 = ATCC 32114 = IMI 141415. ITS barcode: EF652504. (Alternative markers: *BenA* = EF652328; *CaM* = EF652416; *RPB2* = EF652240).
- Aspergillus elegans*** Gasperini, Atti Soc. Tosc. Sci. Nat. 8: 328. 1887. [MB212852]. — Herb.: CBS 102.14. Ex-type: CBS 102.14 = CBS 543.65 = NRRL 4850 = IBT 13505 = ATCC 13829 = ATCC 16886 = IFO 4286 = IMI 133962 = QM 8912 = QM 9373 = WB 4850. ITS barcode: EF661414. (Alternative markers: *BenA* = EF661349; *CaM* = EF661390; *RPB2* = EF661316).
- Aspergillus ellipticus*** Raper & Fennell, Gen. *Aspergillus*: 319. 1965. [MB326628]. — Herb.: CBS 707.79. Ex-type: CBS 482.65 = CBS 707.79 = NRRL 5120 = ATCC 16876 = IMI 172283 = NRRL 20624 = QM 8886 = WB 5120. ITS barcode: EF661194. (Alternative markers: *BenA* = EF661122; *CaM* = EF661170; *RPB2* = EF661051).
- Aspergillus elongatus*** J.N. Rai & S.C. Agarwal, Can. J. Bot. 48: 791. 1970. [MB309217]. — Herb.: CBS 387.75. Ex-type: CBS 387.75 = NRRL 5176 = QM 9702 = WB 5495. ITS barcode: EF652502. (Alternative markers: *BenA* = EF652326; *CaM* = EF652414; *RPB2* = EF652238).
- Aspergillus eucalypticola*** Varga, Frisvad & Samson, Stud. Mycol. 69: 9. 2011. [MB560387]. — Herb.: CBS H-20627. Ex-type: CBS 122712 = IBT 29274. ITS barcode: EU482439. (Alternative markers: *BenA* = EU482435; *CaM* = EU482433; *RPB2* = n.a.).
- Aspergillus falconensis*** Y. Horie *et al.*, Trans. Mycol. Soc. Japan 30: 257. 1989 = *Emericella falconensis* Y. Horie *et al.*, Trans. Mycol. Soc. Japan 30: 257. 1989. [MB127891]. — Herb.: CBM 10001. Ex-type: CBS 271.91 = IFM 4997 = NHL 2999 = ATCC 76117. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus felis*** Barrs *et al.*, PLoS ONE 8: e64871-P8. 2013. [MB560382]. — Herb.: CBS H-21125. Ex-type: CBS 130245. ITS barcode: JX021685. (Alternative markers: *BenA* = JX021700; *CaM* = JX021715; *RPB2* = n.a.).
- Aspergillus fennelliae*** Kwon-Chung & S.J. Kim, Mycologia 66: 629. 1974 = *Neosartorya fennelliae* Kwon-Chung & S.J. Kim, Mycologia 66: 629. 1974. [MB309218]. — Herb.: IMI 278382. Ex-type: CBS 598.74 = NRRL 5534 = ATCC 24325 = IMI 278382 = PIL605 = QM 9952. ITS barcode: EF669994. (Alternative markers: *BenA* = AF057320; *CaM* = EF669920; *RPB2* = EF669781).
- Aspergillus ferenczii*** (Varga & Samson) Samson *et al.*, published here = *Neosartorya ferenczii* Varga & Samson, Stud. Mycol. 59: 178. 2007. [MB809588]. — Herb.: CBS 121594. Ex-type: CBS 121594 = NRRL 4179 = IBT 27813 = DTO24F2. ITS barcode: EF669977. (Alternative markers: *BenA* = EF669833; *CaM* = EF669903; *RPB2* = EF669764).
- Aspergillus filifer*** Zalar, Frisvad & Samson [as '*filifera*'], Mycologia 100: 787. 2008 = *Emericella filifera* Zalar, Frisvad & Samson, Mycologia 100: 787. 2008. [MB540309]. — Herb.: CBS H-19886. Ex-type: CBS 113636 = IBT 23443. ITS barcode: EU448277. (Alternative markers: *BenA* = EF428372; *CaM* = EU443973; *RPB2* = n.a.).
- Aspergillus fischeri*** Wehmer, Zentbl. Bakt. ParasitKde, Abt. II 18: 390. 1907 = *Neosartorya fischeri* (Wehmer) Malloch & Cain, Can. J. Bot. 50: 2620. 1973 = *Aspergillus fischerianus* Samson & W. Gams, Adv. *Penicillium* *Aspergillus* Syst.: 39. 1985. [MB202877]. — Herb.: IMI 21139ii. Ex-type: CBS 544.65 = NRRL 181 = ATCC 1020 = DSM 3700 = IMI 211391 = QM 1983 = Thom 4651.2 = WB 181. ITS barcode: EF669936. (Alternative markers: *BenA* = EF669796; *CaM* = EF669865; *RPB2* = EF669724).
- Aspergillus flaschentraegeri*** Stolk, Trans. Brit. Mycol. Soc. 47: 123. 1964. [MB326629]. — Herb.: CBS 108.63. Ex-type: CBS 108.63 = NRRL 5042 = ATCC 15535 = IMI 101651 = QM 8889 = WB 5042. ITS barcode: EF652150. (Alternative markers: *BenA* = EF652113; *CaM* = EF652130; *RPB2* = EF652102).
- Aspergillus flavipes*** (Bainier & Sartory) Thom & Church, Aspergilli: 155. 1926 = *Sterigmatocystis flavipes* Bainier & Sartory, Bull. Soc. Mycol. Fr. 27: 90. 1911. [MB265045]. — Herb.: IMI 171885. Ex-type: NRRL 302 = ATCC 24487 = IMI 171885 = QM 9566 = Thom 4640.474 = WB 302. ITS barcode: EF669591. (Alternative markers: *BenA* = EU014085; *CaM* = EF669549; *RPB2* = EF669633).
- Aspergillus flavus*** Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809: Fr. [MB209842]. — Herb.: IMI 124930. Ex-type: CBS 569.65 = NRRL

- 1957 = ATCC 16883 = IMI 124930 = QM 9947 = WB 1957. ITS barcode: AF027863. (Alternative markers: *BenA* = EF661485; *CaM* = EF661508; *RPB2* = EF661440).
- Aspergillus floccosus*** (Y.K. Shih) Samson *et al.*, Stud. Mycol. 69: 45. 2011. [MB560393]. — Herb.: unknown. Ex-type: CBS 116.37 = IBT 10846 = IBT 22556 = WB 4872. ITS barcode: FJ531205. (Alternative markers: *BenA* = FJ491714; *CaM* = FJ531219; *RPB2* = n.a.).
- Aspergillus flocculosus*** Frisvad & Samson, Stud. Mycol. 50: 33. 2004. [MB500003]. — Herb.: CBS H-13435. Ex-type: CBS 112785 = NRRL 35668 = IBT 23121. ITS barcode: EF661432. (Alternative markers: *BenA* = EF661352; *CaM* = EF661371; *RPB2* = n.a.).
- Aspergillus floridensis*** Jurjevic, G. Perrone & S.W. Peterson, IMA Fungus 3: 169. 2012. [MB802363]. — Herb.: BPI 883907. Ex-type: NRRL 62478 = ITEM 14783. ITS barcode: n.a. (Alternative markers: *BenA* = HE984412; *CaM* = HE984429; *RPB2* = HE984376).
- Aspergillus floriformis*** Samson & Mouch., Antonie van Leeuwenhoek 40: 343. 1975. [MB309219]. — Herb.: CBS 937.73. Ex-type: CBS 937.73 = IMI 278380. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus foeniculicola*** Udagawa, Trans. Mycol. Soc. Japan 20: 13. 1979 = *Emericella foeniculicola* Udagawa, Trans. Mycol. Soc. Japan 20: 13. 1979. [MB309220]. — Herb.: NHL 2777. Ex-type: CBS 156.80 = ATCC 42155 = IMI 334933 = LCP 84.2560 = NHL 2777. ITS barcode: EU448274. (Alternative markers: *BenA* = EU443990; *CaM* = EU443968; *RPB2* = n.a.).
- Aspergillus foveolatus*** Y. Horie, Trans. Mycol. Soc. Japan 19: 313. 1978 = *Emericella foveolata* Y. Horie, Trans. Mycol. Soc. Japan 19: 313. 1978. [MB309221]. — Herb.: IFM 4547. Ex-type: CBS 279.81 = IFM 4547 = NHL 2839 = NBRC 30559 = IFO 30559. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus frequens*** Hubka *et al.*, Mycologia (in press). [MB808141]. — Herb.: PRM 923458. Ex-type: NRRL 4578 = ATCC 16805 = CBS 586.65 = IMI 135423 = CCF 4555. ITS barcode: EF669602. (Alternative markers: *BenA* = EU014082; *CaM* = EF669560; *RPB2* = EF669644).
- Aspergillus fresenii*** Subram., Hyphomycetes (New Delhi): 552. 1971 = *Sterigmatocystis sulphurea* Fresen., Beitr. Mykol.: 83. 1863. [MB309222]. — Herb.: IMI 211397. Ex-type: CBS 550.65 = NRRL 4077 = ATCC 16893 = IMI 211397 = NRRL A-5355 = NRRL A-5520 = WB 4077. ITS barcode: EF661409. (Alternative markers: *BenA* = EF661341; *CaM* = EF661382; *RPB2* = EF661296). Note: previously incorrectly named *Aspergillus sulphureus* (Fresen.) Wehmer (Visagie *et al.* 2014a, 2014b).
- Aspergillus fructus*** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 70. 2012. [MB800600]. — Herb.: BPI 880915. Ex-type: NRRL 239. ITS barcode: EF652449. (Alternative markers: *BenA* = EF652273; *CaM* = EF652361; *RPB2* = EF652185).
- Aspergillus fruticosus*** Raper & Fennell, Gen. *Aspergillus*: 506. 1965 = *Emericella fruticulosa* (Raper & Fennell) Malloch & Cain, Can. J. Bot. 50: 61. 1972 = *Aspergillus fruticans* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 40. 1985. [MB326630]. — Herb.: IMI 139279. Ex-type: CBS 486.65 = NRRL 4903 = ATCC 16823 = IMI 139279 = O-1077 = QM 8033 = WB 4903. ITS barcode: EF652483. (Alternative markers: *BenA* = EF652307; *CaM* = EF652395; *RPB2* = EF652219).
- Aspergillus fumigatiformis*** S.B. Hong, Frisvad & Samson, Mycologia 97: 1326. 2006. [MB500296]. — Herb.: CBS 117186. Ex-type: CBS 117186 = IBT 12703. ITS barcode: n.a. (Alternative markers: *BenA* = DQ094885; *CaM* = DQ094891; *RPB2* = n.a.).
- Aspergillus fumigatus*** Fresen., Beitr. Mykol.: 81. 1863 = *Neosartorya fumigata* O'Gorman, H.T. Fuller & P.S. Dyer, Nature, Lond. 457(no. 7228): 473. 2009. [MB211776]. — Herb.: IMI 16152. Ex-type: CBS 133.61 = NRRL 163 = ATCC 1022 = ATCC 4813 = IMI 16152 = LSHBA c.71 = NCTC 982 = QM 1981 = Thom 118 = WB 163. ITS barcode: EF669931. (Alternative markers: *BenA* = EF669791; *CaM* = EF669860; *RPB2* = EF669719).
- Aspergillus fumisynnematus*** Y. Horie *et al.*, Trans. Mycol. Soc. Japan 34: 3. 1993. [MB360061]. — Herb.: CBM FD-0001. Ex-type: IFM 42277. ITS barcode: AB250779. (Alternative markers: *BenA* = AB248076; *CaM* = AB259968; *RPB2* = n.a.).
- Aspergillus funiculosus*** G. Sm., Trans. Brit. Mycol. Soc. 39: 111. 1956. [MB292845]. — Herb.: IMI 44397. Ex-type: NRRL 4744 = NRRL 2550 = NRRL A-6752. ITS barcode: EF661223. (Alternative markers: *BenA* = EF661112; *CaM* = EF661175; *RPB2* = EF661078).
- Aspergillus galapagensis*** (Frisvad, S.B. Hong & Samson) Samson, Frisvad & Houben = *Neosartorya galapagensis* Frisvad, S.B. Hong & Samson, Antonie van Leeuwenhoek 93: 96. 2008. [MB809589]. — Herb.: CBS 117522. Ex-type: CBS 117522 = IBT 16756 = KACC 41935 = DTO3H4. ITS barcode: n.a. (Alternative markers: *BenA* = DQ534145; *CaM* = DQ534151; *RPB2* = n.a.).
- Aspergillus germanicus*** Frisvad, Varga & Samson, Stud. Mycol. 69: 91. 2011. [MB560401]. — Herb.: CBS H-20636. Ex-type: CBS 123887. ITS barcode: FJ531146. (Alternative markers: *BenA* = FJ531172; *CaM* = FJ531141; *RPB2* = n.a.).
- Aspergillus giganteus*** Wehmer, Mem. Soc. Phys. Genève 33: 85. 1901. [MB206765]. — Herb.: IMI 227678. Ex-type: CBS 526.65 = NRRL 10 = ATCC 10059 = DSM 1146 = IFO 5818 = IMI 227678 = QM 1970 = Thom 5581.13A = WB 10. ITS barcode: EF669928. (Alternative markers: *BenA* = EF669789; *CaM* = EF669857; *RPB2* = EF669716).
- Aspergillus glaucus*** (L.) Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809 = *Mucor glaucus* L., Sp. Pl.: 1186. 1753 = *Monilia glauca* (L.) Pers., Syn. meth. fung.: 691. 1801 = *Eurotium herbariorum* (Weber ex F.H. Wigg.) Link, Mag. Gesell. Naturf. Freunde, Berlin 3: 31. 1809. [MB161735]. — Herb.: IMI 211383. Ex-type: CBS 516.65 = NRRL 116 = ATCC 16469 = IMI 211383 = LCP 64.1859 = Thom 5629.C = WB 116. ITS barcode: EF652052. (Alternative markers: *BenA* = EF651887; *CaM* = EF651989; *RPB2* = EF651934).
- Aspergillus gorakhpurensis*** Kamal & Bhargava, Trans. Brit. Mycol. Soc. 52: 338. 1969. [MB326632]. — Herb.: IMI 130728. Ex-type: CBS 648.74 = NRRL 3649 = IMI 130728 = QM 9187 = WB 5346. ITS barcode: EF652145. (Alternative markers: *BenA* = EF652114; *CaM* = EF652126; *RPB2* = EF652097).
- Aspergillus gracilis*** Bainier, Bull. Soc. Mycol. France 23: 90. 1907. [MB167554]. — Herb.: IMI 211393. Ex-type: CBS 539.65 = NRRL 4962 = ATCC 16906 = IMI 211393 = QM 8915 = WB 4962. ITS barcode: EF652045. (Alternative markers: *BenA* = EF651883; *CaM* = EF652031; *RPB2* = EF651980).
- Aspergillus granulosis*** Raper & Thom, Mycologia 36: 565. 1944. [MB284302]. — Herb.: IMI 17278ii. Ex-type: NRRL 1932 = ATCC 16837 = IMI 17278 = QM 6846 = WB 1932. ITS barcode: EF652430. (Alternative markers: *BenA* = EF652254; *CaM* = EF652342; *RPB2* = EF652166).
- Aspergillus griseoaurantiacus*** Visagie, Hirooka & Samson, Stud. Mycol. 78: 112. 2014. [MB809197]. — Herb.: CBS H-21814. Ex-type: CBS 138191 = DTO 267D8. ITS barcode: KJ775553. (Alternative markers: *BenA* = KJ775086; *CaM* = KJ775357; *RPB2* = n.a.).
- Aspergillus haitiensis*** Varga, Frisvad & Samson, IMA Fungus 1: 194. 2010. [MB517384]. — Herb.: CBS H-20503. Ex-type: CBS 464.91. ITS barcode: FJ491657. (Alternative markers: *BenA* = FJ491670; *CaM* = FJ491645; *RPB2* = n.a.).
- Aspergillus halophilicus*** C.M. Chr. *et al.*, Mycologia 51: 636. 1961 = *Eurotium halophilicum* C.M. Chr., Papav. & C.R. Benj., Mycologia 51: 636. 1961 [1959]. [MB326633]. — Herb.: BPI 566153. Ex-type: CBS 122.62 = NRRL 2739 = ATCC 16401 = IFO 7054 = IMI 211802 = NRRL 4679 = NRRL A-7206 = QM 8894 = WB 4679. ITS barcode: EF652088. (Alternative markers: *BenA* = EF651926; *CaM* = EF652034; *RPB2* = EF651982).
- Aspergillus heteromorphus*** Bat. & H. Maia, Anais Soc. Biol. Pernambuco 15: 200. 1957. [MB292846]. — Herb.: IMI 172288. Ex-type: CBS 117.55 = NRRL 4747 = ATCC 12064 = IMI 172288 = QM 6954 = WB 4747. ITS barcode: EU821305. (Alternative markers: *BenA* = EF661103; *CaM* = EF661169; *RPB2* = EF661050).
- Aspergillus heterothallicus*** Kwon-Chung *et al.*, Gen. *Aspergillus*: 502. 1965 = *Emericella heterothallica* (Kwon-Chung, Fennell & Raper) Malloch & Cain, Can. J. Bot. 50: 62. 1972 = *Aspergillus compatibilis* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 42. 1985. [MB326635]. — Herb.: CBS 488.65. Ex-type: CBS 488.65 = NRRL 5096 = ATCC 16847 = IMI 139277 = QM 8916 = WB 5096. ITS barcode: EF652499. (Alternative markers: *BenA* = EF652323; *CaM* = EF652411; *RPB2* = EF652235).
- Aspergillus heyangensis*** Z.T. Qi, Z.M. Sun & Yu X. Wang, Acta Mycol. Sin. 13: 81. 1994. [MB414654]. — Herb.: HMAS 58982. Ex-type: CBS 101751. ITS barcode: FJ491520. (Alternative markers: *BenA* = FJ491521; *CaM* = FJ491522; *RPB2* = n.a.).
- Aspergillus hiratsukae*** Udagawa *et al.*, Trans. Mycol. Soc. Japan 32: 23. 1991 = *Neosartorya hiratsukae* Udagawa, Tsub. & Y. Horie, Trans. Mycol. Soc. Japan 32: 23. 1991. [MB354908]. — Herb.: NHL 3008. Ex-type: CBS 294.93 = NRRL 20820 = IMI 349859 = NHL 3008. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = AY870699; *RPB2* = n.a.).
- Aspergillus homomorphus*** Steiman, *et al.* ex Samson & Frisvad, Stud. Mycol. 50: 58. 2004. [MB500011]. — Herb.: CBS H-13440. Ex-type: CBS 101889. ITS barcode: EF166063. (Alternative markers: *BenA* = AY820015; *CaM* = FN594549; *RPB2* = n.a.).
- Aspergillus hortai*** (Langeron) C.W. Dodge, Medical Mycology. Fungous diseases of men and other mammals: 628. 1935. [MB252620]. — Herb.: unknown. Ex-type: CBS 124230 = NRRL 274 = ATCC 10070 = IBT 26384. ITS

- barcode: FJ531192. (Alternative markers: *BenA* = FJ491706; *CaM* = FJ531242; *RPB2* = n.a.).
- Aspergillus huiyianiae*** Y. Horie *et al.*, Mycoscience 55: 218. 2014. [MB803656]. — Herb.: IFM 57847H. Ex-type: IFM 57847 = JCM 19448. ITS barcode: n.a. (Alternative markers: *BenA* = AB787219; *CaM* = AB787564; *RPB2* = n.a.).
- Aspergillus ibericus*** R. Serra, J. Cabañes & G. Perrone, Mycologia 98: 298. 2006. [MB501326]. — Herb.: MUM-H 03.49. Ex-type: NRRL 35644. ITS barcode: EF661200. (Alternative markers: *BenA* = EF661102; *CaM* = EF661163; *RPB2* = EF661065).
- Aspergillus iizukae*** Sugiy., J. Fac. Sci. Tokyo University, Section 3 9: 390. 1967. [MB326636]. — Herb.: TI 0007. Ex-type: CBS 541.69 = NRRL 3750 = IMI 141552 = QM 9325. ITS barcode: EF669597. (Alternative markers: *BenA* = EU014086; *CaM* = EF669555; *RPB2* = EF669639).
- Aspergillus implicatus*** Persiani & Maggi, Mycol. Res. 98: 871. 1994. [MB362533]. — Herb.: ROHB 110 S. Ex-type: CBS 484.95. ITS barcode: FJ491656. (Alternative markers: *BenA* = FJ491667; *CaM* = FJ491650; *RPB2* = n.a.).
- Aspergillus indologenus*** Frisvad, Varga & Samson, Stud. Mycol. 69: 9. 2011. [MB560389]. — Herb.: CBS H-20629. Ex-type: CBS 114.80 = IBT 3679 = ITEM 7038. ITS barcode: AJ280005. (Alternative markers: *BenA* = AY585539; *CaM* = AM419750; *RPB2* = HE984366).
- Aspergillus inflatus*** (Stolk & Malla) Samson, Frisvad, Varga, Visagie & Houbraken, published here \equiv *Penicillium inflatum* Stolk & Malla, Persoonia 6: 197. 1971. [MB809590]. — Herb.: CBS H-7500. Ex-type: CBS 682.70 = FRR 1549 = IMI 191498. ITS barcode: FJ531054. (Alternative markers: *BenA* = FJ531008; *CaM* = FJ531090; *RPB2* = JN406529).
- Aspergillus insolitus*** (G. Sm.) Houbraken, Visagie & Samson, published here \equiv *Polypaecilum insolitum* G. Sm., Trans. Brit. Mycol. Soc. 44: 437. 1961. [MB809591]. — Herb.: CBS 384.61. Ex-type: CBS 384.61 = ATCC 18164 = IFO 8788 = IMI 075202 = LSHB BB414 = MUCL 3078 = QM 7961. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = JN121510).
- Aspergillus insuetus*** (Bainier) Thom & Church, Manual of the Aspergilli: 153. 1929 \equiv *Sterigmatocystis insueta* Bainier, Bull. Soc. Mycol. France 24: 85. 1908. [MB267997]. — Herb.: CBS 107.25. Ex-type: CBS 107.25 = NRRL 279 = NRRL 1726 = ATCC 1033 = IFO 4128. ITS barcode: EF652457. (Alternative markers: *BenA* = EF652281; *CaM* = EF652369; *RPB2* = EF652193).
- Aspergillus insulicola*** Montem. & A. R. Santiago, Mycopathologia 55: 130. 1975. [MB309225]. — Herb.: CBS 382.75. Ex-type: CBS 382.75 = NRRL 6138 = ATCC 26220. ITS barcode: EF661430. (Alternative markers: *BenA* = EF661353; *CaM* = EF661396; *RPB2* = EF661286).
- Aspergillus intermedius*** Blaser, Sydowia 28: 41. 1976 \equiv *Eurotium intermedium* Blaser, Sydowia 28: 41. 1976. [MB309226]. — Herb.: IMI 89278. Ex-type: CBS 523.65 = NRRL 82 = ATCC 16444 = DSM 2830 = IMI 089278ii = IMI 89278 = LSHBBB 107 = LSHTM 107 = QM 7403 = Thom 5612.107 = WB 82. ITS barcode: EF652074. (Alternative markers: *BenA* = EF651892; *CaM* = EF652012; *RPB2* = EF651958).
- Aspergillus itaconicus*** Kinosh., Bot. Mag. (Tokyo) 45: 60. 1931. [MB268225]. — Herb.: IMI 16119. Ex-type: CBS 115.32 = NRRL 161 = ATCC 10021 = IHEM 4378 = IMI 16119 = LSHBA 48 = MUCL 31306 = QM 1980 = Thom 5344 = Thom 5660.48 = WB 161. ITS barcode: EF652147. (Alternative markers: *BenA* = EF652118; *CaM* = EF652140; *RPB2* = EF652103).
- Aspergillus ivoriensis*** Bartoli & Maggi, Trans. Brit. Mycol. Soc. 71: 383. 1979. [MB309228]. — Herb.: RO 101 S. Ex-type: CBS 551.77 = NRRL 22883. ITS barcode: EF652441. (Alternative markers: *BenA* = EF652265; *CaM* = EF652353; *RPB2* = EF652177).
- Aspergillus jaipurensis*** Samson, Visagie & Houbraken, published here \equiv *Emericella indica* Stchigel & Guarro, Mycol. Res. 103: 1059. 1999. [MB809592]. — Herb.: IMI 378525. Ex-type: IMI 378525. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Non *Aspergillus indicus* B.S. Mehrotra & Agnihotri, Mycologia 54: 403. 1963.
- Aspergillus janus*** Raper & Thom, Mycologia 36: 556. 1944. [MB284303]. — Herb.: IMI 16065. Ex-type: CBS 118.45 = NRRL 1787 = IMI 16065 = NCTC 6970. ITS barcode: EF669578. (Alternative markers: *BenA* = EU014076; *CaM* = EF669536; *RPB2* = EF669620).
- Aspergillus japonicus*** Saito, Bot. Mag. (Tokyo) 20: 61. 1906. [MB160656]. — Herb.: CBS 114.51. Ex-type: CBS 114.51. ITS barcode: AJ279985. (Alternative markers: *BenA* = HE577804; *CaM* = FN594551; *RPB2* = n.a.).
- Aspergillus jensenii*** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 70. 2012. [MB800601]. — Herb.: BPI 880910. Ex-type: NRRL 58600. ITS barcode: JQ301892. (Alternative markers: *BenA* = JN854007; *CaM* = JN854046; *RPB2* = JN853835).
- Aspergillus kanagawaensis*** Nehira, J. Jap. Bot. 26: 109. 1951. [MB292847]. — Herb.: IMI 126690. Ex-type: NRRL 4774 = NRRL 2854 = NRRL 3156 = NRRL A-13499 = IMI 126690. ITS barcode: EF661275. (Alternative markers: *BenA* = EF661239; *CaM* = EF661263; *RPB2* = EF661236).
- Aspergillus karnatakaensis*** Varga, Frisvad & Samson, IMA Fungus 1: 203. 2010. [MB517549]. — Herb.: CBS H-20502. Ex-type: CBS 102800 = IBT 22153. ITS barcode: EU482441. (Alternative markers: *BenA* = EU482438; *CaM* = EU482431; *RPB2* = n.a.).
- Aspergillus kassunensis*** Baghd., Nov. Sist. Niz. Rast., 5: 113. 1968. [MB326639]. — Herb.: unknown. Ex-type: CBS 419.69 = NRRL 3752 = IMI 334938. ITS barcode: EF652461. (Alternative markers: *BenA* = EF652285; *CaM* = EF652373; *RPB2* = EF652197).
- Aspergillus keveii*** Varga, Frisvad & Samson, Stud. Mycol. 59: 120. 2007. [MB505570]. — Herb.: CBS 209.92. Ex-type: CBS 209.92. ITS barcode: EU076354. (Alternative markers: *BenA* = EU076376; *CaM* = EU076365; *RPB2* = n.a.).
- Aspergillus laciniosus*** S.B. Hong, Frisvad & Samson, Int. J. Syst. Evol. Microbiol. 56: 484. 2006 \equiv *Neosartorya laciniosa* S.B. Hong, Frisvad & Samson, Int. J. Syst. Evol. Microbiol. 56: 484. 2006. [MB521269]. — Herb.: CBS 117721. Ex-type: CBS 117721 = NRRL 35589 = KACC 41657. ITS barcode: AB299413. (Alternative markers: *BenA* = AY870756; *CaM* = AY870716; *RPB2* = n.a.).
- Aspergillus lacticoffeatus*** Frisvad & Samson, Stud. Mycol. 50: 52. 2004. [MB500008]. — Herb.: CBS H-13436. Ex-type: CBS 101883 = IBT 22031 = ITEM 7559. ITS barcode: FJ629336. (Alternative markers: *BenA* = AY819998; *CaM* = EU163270; *RPB2* = HE984367).
- Aspergillus lanosus*** Kamal & Bhargava, Trans. Brit. Mycol. Soc. 52: 336. 1969. [MB326640]. — Herb.: IMI 130727. Ex-type: CBS 650.74 = NRRL 3648 = IMI 130727 = QM 9183 = WB 5347. ITS barcode: EF661553. (Alternative markers: *BenA* = EF661468; *CaM* = EF661539; *RPB2* = EU021642).
- Aspergillus lentulus*** Balajee & K.A. Marr, Eukaryot. Cell 4: 631. 2005. [MB356679]. — Herb.: BPI 863540. Ex-type: CBS 117885 = NRRL 35552 = IBT 27201 = KACC 41940. ITS barcode: EF669969. (Alternative markers: *BenA* = EF669825; *CaM* = EF669895; *RPB2* = EF669756).
- Aspergillus leporis*** States & M. Chr., Mycologia 58: 738. 1966. [MB326641]. — Herb.: NY RMF 99. Ex-type: CBS 151.66 = NRRL 3216 = ATCC 16490 = NRRL A-14256 = NRRL A-15810 = QM 8995 = RMF99 = WB 5188. ITS barcode: AF104443. (Alternative markers: *BenA* = EF661499; *CaM* = EF661541; *RPB2* = EF661459).
- Aspergillus leucocarpus*** Hadlok & Stolk, Antonie van Leeuwenhoek 35: 9. 1969 \equiv *Eurotium leucocarpum* Hadlok & Stolk, Antonie van Leeuwenhoek 35: 9. 1969. [MB326642]. — Herb.: CBS 353.68. Ex-type: CBS 353.68 = NRRL 3497 = QM 9365 = QM 9707. ITS barcode: EF652087. (Alternative markers: *BenA* = EF651925; *CaM* = EF652023; *RPB2* = EF651972).
- Aspergillus longivesica*** L.H. Huang & Raper, Mycologia 63: 53. 1971. [MB309229]. — Herb.: WIS NI 179. Ex-type: CBS 530.71 = NRRL 5215 = ATCC 22434 = IMI 156966 = JCM 10186 = QM 9698. ITS barcode: EF669991. (Alternative markers: *BenA* = EF669847; *CaM* = EF669917; *RPB2* = EF669778).
- Aspergillus luchuensis*** Inui, J. Coll. Agric. Imp. Univ. Tokyo 13: 469. 1901. [MB151291]. — Herb.: unknown. Ex-type: CBS 205.80 = NBRC 4281 = KACC 46772 = IFM 47726 = RIB 2642. ITS barcode: JX500081. (Alternative markers: *BenA* = JX500062; *CaM* = JX500071; *RPB2* = n.a.).
- Aspergillus lucknowensis*** J. N. Rai *et al.*, Can. J. Bot. 46: 1483. 1968. [MB326643]. — Herb.: CBS 449.75. Ex-type: CBS 449.75 = NRRL 3491 = ATCC 18607 = IMI 278379 = PIL623 = QM 9271 = WB 5377. ITS barcode: EF652459. (Alternative markers: *BenA* = EF652283; *CaM* = EF652371; *RPB2* = EF652195).
- Aspergillus luppii*** Hubka *et al.*, Mycologia (in press). [MB309211]. — Herb.: CBS 653.74. Ex-type: NRRL 6326 = CBS 653.74 = CCF 4545. ITS barcode: EF669617. (Alternative markers: *BenA* = EU014079; *CaM* = EF669575; *RPB2* = EF669659).
- Aspergillus mangaliensis*** A. Nováková *et al.*, Mycologia (in press). [MB808143]. — Herb.: PRM 923454. Ex-type: CCF 4698 = CMF ISB 2662 = NRRL 62825. ITS barcode: HG915902 (Alternative markers: *BenA* = HG916695; *CaM* = HG916738; *RPB2* = HG916716).
- Aspergillus maritimus*** Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 43. 1985 \equiv *Hemisartorya maritima* J.N. Rai & H.J. Chowdhery, Kavaka 3: 73. 1976. [MB114709]. — Herb.: CBS 186.77. Ex-type: CBS 186.77. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).

- Aspergillus marvanovae** Hubka *et al.*, Int. J. Syst. Evol. Microbiol. 63: 787. 2013. [MB801064]. — Herb.: PRM 860539. Ex-type: NRRL 62486 = IBT 31279 = CCM 8003 = CCF 4037 IFM 60873. ITS barcode: HE974450. (Alternative markers: *BenA* = HE974387; *CaM* = HE974389; *RPB2* = HE974396).
- Aspergillus melleus** Yukawa, J. Coll. Agric. Imp. Univ. Tokyo 1: 358. 1911. [MB164593]. — Herb.: CBS 546.65. Ex-type: CBS 546.65 = NRRL 5103 = IBT 13510 = IBT 13511 = IBT 13875 = ATCC 16889 = WB 5103. ITS barcode: EF661425. (Alternative markers: *BenA* = EF661326; *CaM* = EF661391; *RPB2* = EF661309).
- Aspergillus microcysticus** Sappa, Allionia 2: 251. 1955. [MB292848]. — Herb.: IMI 139275. Ex-type: CBS 120.58 = NRRL 4749 = ATCC 16826 = IMI 139275 = QM 8158 = WB 4749. ITS barcode: EF669607. (Alternative markers: *BenA* = EF669515; *CaM* = EF669565; *RPB2* = EF669649).
- Aspergillus micronesiensis** Visagie, Hirooka & Samson, Stud. Mycol. 78: 105. 2014. [MB809192]. — Herb.: CBS H-21809. Ex-type: CBS 138183 = DTO 267D5. ITS barcode: KJ775548. (Alternative markers: *BenA* = KJ775085; *CaM* = KJ775355; *RPB2* = n.a.).
- Aspergillus miniscloeritigenes** Vaamonde, Frisvad & Samson, Int. J. Syst. Evol. Microbiol. 58: 733. 2008. [MB505188]. — Herb.: unknown. Ex-type: CBS 117635 = IBT 25032. ITS barcode: EF409239. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus miyajii** Y. Horie, Mycoscience 37: 323. 1997 [1996] = *Emericella miyajii* Y. Horie, Mycoscience 37: 323. 1997, [1996]. [MB437698]. — Herb.: CBM FA-0716. Ex-type: CBM FA-0716. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus monodii** (Locq.-Lin.) Varga, Frisvad & Samson, Stud. Mycol. 69: 91. 2011 = *Fennellia monodii* Locq.-Lin., Mycotaxon 39: 10. 1990. [MB560402]. — Herb.: LCP 89-3570 (PC). Ex-type: CBS 435.93. ITS barcode: FJ531150. (Alternative markers: *BenA* = FJ531171; *CaM* = FJ531142; *RPB2* = n.a.).
- Aspergillus montenegroi** Y. Horie, Miyaji & Nishim., Mycoscience 37: 137. 1996 = *Emericella montenegroi* Y. Horie, Miyaji & Nishim., Mycoscience 37: 137. 1996. [MB415939]. — Herb.: CBM FA-0669. Ex-type: CBM FA-0669. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = AB524041; *RPB2* = n.a.).
- Aspergillus montevidensis** Talice & Mackinnon, Compt. Rend. Soc. Biol. Fr. 108: 1007. 1931 = *Eurotium montevidense* (Talice & J.A. Mackinnon) Malloch & Cain, Can. J. Bot. 50: 64. 1972. [MB309231]. — Herb.: BPI 884202. Ex-type: CBS 491.65 = NRRL 108 = ATCC 10077 = IHM 3337 = IMI 172290 = NRRL 109 = QM 7423 = Thom 5290 = Thom 5633.24 = WB 108. ITS barcode: EF652077. (Alternative markers: *BenA* = EF651898; *CaM* = EF652020; *RPB2* = EF651964).
- Aspergillus mottae** C. Soares, S.W. Peterson & Venâncio, Mycologia 104: 692. 2012. [MB561841]. — Herb.: MUM-H 10.231. Ex-type: CBS 130016. ITS barcode: JF412767. (Alternative markers: *BenA* = HM803086; *CaM* = HM803015; *RPB2* = HM802988).
- Aspergillus multicolor** Sappa, Allionia 2: 87. 1954. [MB292849]. — Herb.: IMI 69875. Ex-type: CBS 133.54 = NRRL 4775 = ATCC 16804 = IFO 8133 = IMI 69857 = LSHBBB .356 = QM 1952 = WB 4281 = WB 4775. ITS barcode: EF652477. (Alternative markers: *BenA* = EF652301; *CaM* = EF652389; *RPB2* = EF652213).
- Aspergillus multiplicatus** Yaguchi, Someya & Udagawa, Mycoscience 35: 310. 1994 = *Neosartorya multiplicata* Yaguchi, Someya & Udagawa, Mycoscience 35: 309. 1994. [MB412530]. — Herb.: CBM PF-1154. Ex-type: CBS 646.95 = IBT 17517. ITS barcode: n.a. (Alternative markers: *BenA* = DQ114129; *CaM* = DQ114137; *RPB2* = n.a.).
- Aspergillus muricatus** Udagawa, Uchiy. & Kamiya, Mycotaxon 52: 210. 1994 = *Neopetromyces muricatus* (Udagawa, Uchiy. & Kamiya) Frisvad & Samson, Stud. Mycol., 45: 204. 2004. [MB362530]. — Herb.: CBM BF-42515. Ex-type: CBS 112808 = NRRL 35674 = IBT 19374 = IMI 36852. ITS barcode: EF661434. (Alternative markers: *BenA* = EF661356; *CaM* = EF661377; *RPB2* = EF661314).
- Aspergillus navahoensis** M. Chr. & States, Mycologia 74: 226. 1982 = *Emericella navahoensis* M. Chr. & States, Mycologia 74: 226. 1982. [MB110496]. — Herb.: NY SD-5. Ex-type: CBS 351.81 = NRRL 13002 = ATCC 44663 = IMI 259971. ITS barcode: EF652424. (Alternative markers: *BenA* = EF652248; *CaM* = EF652336; *RPB2* = EF652160).
- Aspergillus neoaficanus** Samson, S.W. Peterson, Frisvad & Varga, Stud. Mycol. 69: 53. 2011 = *Aspergillus terreus* var. *aficanus* Fennell & Raper, Mycologia 47: 86. 1955. [MB560391]. — Herb.: unknown. Ex-type: CBS 130.55 = NRRL 2399 = ATCC 16792 = IHM 4380 = IMI 61457 = MUCL 31316 = NRRL A-3175 = QM 1913 = VKMF-2037 = WB 2399. ITS barcode: AY822633. (Alternative markers: *BenA* = EF669516; *CaM* = EF669543; *RPB2* = EF669627).
- Aspergillus neobridgeri** Frisvad & Samson, Stud. Mycol. 50: 35. 2004. [MB500004]. — Herb.: CBS 559.82. Ex-type: CBS 559.82 = NRRL 13078 = IBT 14026. ITS barcode: EF661410. (Alternative markers: *BenA* = EF661345; *CaM* = EF661359; *RPB2* = EF661298).
- Aspergillus neocarnoyi** Kozak., Mycol. Pap. 161: 63. 1989 = *Eurotium camoyi* Malloch & Cain, Can. J. Bot. 50: 63. 1972. [MB127756]. — Herb.: IMI 172279. Ex-type: CBS 471.65 = NRRL 126 = ATCC 16924 = IMI 172279 = LSHTM A32 = QM 7402 = Thom 5612.A32 = WB 126. ITS barcode: EF652057. (Alternative markers: *BenA* = EF651903; *CaM* = EF651985; *RPB2* = EF651942).
- Aspergillus neoflavipes** Hubka *et al.*, Mycologia (in press) = *Fennellia flavipes* B.J. Wiley & E.G. Simmons, Mycologia 65: 937. 1973. [MB808147]. — Herb.: BPI 410858. Ex-type: CBS 260.73 = NRRL 5504 = ATCC 24484 = IMI 171883 = IFM 40894 = CCF 4552. ITS barcode: EF669614. (Alternative markers: *BenA* = EU014084; *CaM* = EF669572; *RPB2* = EF669656).
- Aspergillus neoglaber** Kozak., Mycol. Pap. 161: 56. 1989 = *Aspergillus fischeri* var. *glaber* Fennell & Raper, Mycologia 47: 74. 1955 = *Sartorya fumigata* var. *glabra* (Fennell & Raper) Udagawa & H. Kawas., Trans. Mycol. Soc. Japan: 115. 1968 = *Neosartorya glabra* (Fennell & Raper) Kozak., Mycol. Pap. 161: 56. 1989. [MB127762]. — Herb.: IMI 61447. Ex-type: CBS 111.55 = NRRL 2163 = ATCC 16909 = IFO 8789 = IMI 061447ii = IMI 367412 = IMI 61447 = NRRL A-2175 = QM 1903 = WB 2163. ITS barcode: EF669948. (Alternative markers: *BenA* = EU014107; *CaM* = EU014120; *RPB2* = EF669736).
- Aspergillus neoindicus** Samson *et al.*, Stud. Mycol. 69: 53. 2011 = *Aspergillus niveus* var. *indicus* Lal & A.K. Sarbhoj [as 'indica'], Indian Phytopath. 25: 311. 1972 [1973]. [MB560394]. — Herb.: unknown. Ex-type: CBS 444.75 = NRRL 6134 = IMI 334935. ITS barcode: EF669616. (Alternative markers: *BenA* = EF669532; *CaM* = EF669574; *RPB2* = EF669658).
- Aspergillus neoniger** Varga, Frisvad & Samson, Stud. Mycol. 69: 16. 2011. [MB560390]. — Herb.: CBS H-20630. Ex-type: CBS 115656 = NRRL 62634. ITS barcode: FJ491682. (Alternative markers: *BenA* = FJ491691; *CaM* = FJ491700; *RPB2* = KC796429).
- Aspergillus neoniveus** Samson *et al.*, Stud. Mycol. 69: 53. 2011 = *Emericella nivea* B.J. Wiley & E.G. Simmons, Mycologia 65: 934. 1973 = *Fennellia nivea* (B.J. Wiley & E.G. Simmons) Samson, Stud. Mycol. 18: 5. 1979. [MB560395]. — Herb.: QM 8942. Ex-type: CBS 261.73 = NRRL 5299 = ATCC 24482 = IMI 171878. ITS barcode: EF669612. (Alternative markers: *BenA* = EU014098; *CaM* = EF669570; *RPB2* = EF669654).
- Aspergillus nidulans** (Eidam) G. Winter, Rabenh. Krypt.-Fl., ed. 2, 1: 62. 1884 = *Sterigmatocystis nidulans* Eidam, Beitr. Biol. Pflanzen 3: 393. 1883 = *Emericella nidulans* (Eidam) Vuill., C. R. hebdom. Séanc. Acad. Sci., Paris 184: 137. 1927. [MB182069]. — Herb.: IMI 86806. Ex-type: CBS 589.65 = NRRL 187 = ATCC 10074 = IHM 3563 = IMI 126691 = IMI 86806 = QM 1985 = Thom 4640.5 = WB 187. ITS barcode: EF652427. (Alternative markers: *BenA* = EF652251; *CaM* = EF652339; *RPB2* = EF652163).
- Aspergillus niger** Tiegh., Ann. Sci. Nat., Bot., ser. 5, 8: 240. 1867, nom. cons. (Kozakiewicz *et al.* 1992). [MB284309]. — Herb.: CBS 554.65. Ex-type: CBS 554.65 = NRRL 326 = ATCC 16888 = IFO 33023 = IHM 3415 = IMI 050566ii = IMI 50566 = JCM 10254 = QM 9270 = QM 9946 = Thom 2766 = WB 326. ITS barcode: EF661186. (Alternative markers: *BenA* = EF661089; *CaM* = EF661154; *RPB2* = EF661058).
- Aspergillus nishimurae** Takada, Y. Horie & Abliz, Mycoscience 42: 362. 2001 = *Neosartorya nishimurae* Takada, Y. Horie & Abliz, Mycoscience 42: 361. 2001. [MB474712]. — Herb.: CBM FA-919. Ex-type: CBS 117265 = IBT 3016 (representative strain). ITS barcode: HE974451. (Alternative markers: *BenA* = DQ534154; *CaM* = HE974392; *RPB2* = HE974395).
- Aspergillus niveoglauca** Thom & Raper, U.S.D.A. Misc. Pub. 426: 35. 1941 = *Eurotium niveoglauca* (Thom & Raper) Malloch & Cain, Can. J. Bot. 50: 64. 1972. [MB120985]. — Herb.: IMI 32050ii. Ex-type: CBS 114.27 = CBS 517.65 = NRRL 127 = ATCC 10075 = IMI 32050 = LSHBA 16 = NRRL 129 = NRRL 130 = QM 1977 = Thom 5612.A16 = Thom 5633 = Thom 5633.7 = Thom 7053.2 = WB 127 = WB 130. ITS barcode: EF652058. (Alternative markers: *BenA* = EF651905; *CaM* = EF651993; *RPB2* = EF651943).
- Aspergillus niveus** Blochwitz, Ann. Mycol. 27: 205. 1929 [MB272402]. — Herb.: IMI 171878. Ex-type: CBS 115.27 = NRRL 5505. ITS barcode: EF669615. (Alternative markers: *BenA* = EF669528; *CaM* = EF669573; *RPB2* = EF669657).
- Aspergillus nomius** Kurtzman *et al.*, Antonie van Leeuwenhoek 53: 151. 1987. [MB133392]. — Herb.: BPI NRRL 13137. Ex-type: CBS 260.88 = NRRL 13137 = ATCC 15546 = FRR 3339 = IMI 331920 = LCP 89.3558 = NRRL

- 6108 = NRRL A-13671 = NRRL A-13794. ITS barcode: AF027860. (Alternative markers: *BenA* = AF255067; *CaM* = AY017588; *RPB2* = EF661456).
- Aspergillus novofumigatus*** S.B. Hong, Frisvad & Samson, Mycologia 97: 1368. 2006. [MB500297]. — Herb.: CBS 117520. Ex-type: CBS 117520 = IBT 16806. ITS barcode: n.a. (Alternative markers: *BenA* = DQ094886; *CaM* = DQ094893; *RPB2* = n.a.).
- Aspergillus nutans*** McLennan & Ducker, Aust. J. Bot. 2: 355. 1954. [MB292850]. — Herb.: IMI 62874ii. Ex-type: CBS 121.56 = NRRL 575 = NRRL 4364 = NRRL A-6280 = ATCC 16914 = IFO 8134 = IMI 062874ii = IMI 62874 = QM 8159 = WB 4364 = WB 4546 = WB 4776. ITS barcode: EF661272. (Alternative markers: *BenA* = EF661249; *CaM* = EF661262; *RPB2* = EF661227).
- Aspergillus occultus*** Visagie *et al.*, Stud. Mycol. 78: 32. 2014. [MB809198]. — Herb.: CBS H-21794. Ex-type: CBS 137330 = IBT 32285 = DTO 231-A7. ITS barcode: KJ775443. (Alternative markers: *BenA* = KJ775061; *CaM* = KJ775239; *RPB2* = n.a.).
- Aspergillus ochraceopetaliformis*** Bat. & Maia, Anais Soc. Biol. Pernambuco 15: 213. 1957. [MB292851]. — Herb.: no 270, Instituto de Micologia, Universidade do Recife. Ex-type: CBS 123.55 = NRRL 4752 = IBT 14347 = ATCC 12066 = IMI 211804 = QM 6955 = WB 4752. ITS barcode: EF661429. (Alternative markers: *BenA* = EF661350; *CaM* = EF661388; *RPB2* = EF661283).
- Aspergillus ochraceoroseus*** Bartoli & Maggi, Trans. Brit. Mycol. Soc. 71: 393. 1979. [MB309233]. — Herb.: RO 104 S. Ex-type: CBS 550.77 = NRRL 28622 = ATCC 38873 = SRRC1432. ITS barcode: EF661224. (Alternative markers: *BenA* = EF661113; *CaM* = EF661137; *RPB2* = EF661074).
- Aspergillus ochraceus*** K. Wilh., Beitr. Kenntn. *Aspergillus*: 66. 1877. [MB190223]. — Herb.: IMI 16247iv. Ex-type: CBS 108.08 = NRRL 398 = IBT 11952 = ATCC 1008 = CECT2093 = DSM 824 = HARVARD296 = IMI 16247 = NCTC 3889 = NRRL 1642 = QM 6731 = Thom 112 = WB 398. ITS barcode: EF661419. (Alternative markers: *BenA* = EF661322; *CaM* = EF661381; *RPB2* = EF661302).
- Aspergillus olivicola*** Frisvad, Zalar & Samson, Mycologia 100: 781. 2008 ≡ *Emericella olivicola* Frisvad, Zalar & Samson, Mycologia 100: 788. 2008. [MB507362]. — Herb.: CBS H-19888. Ex-type: CBS 119.37 = IBT 21903. ITS barcode: EU448268. (Alternative markers: *BenA* = AY339996; *CaM* = EU443986; *RPB2* = n.a.).
- Aspergillus omanensis*** Y. Horie & Udagawa, Mycoscience 36: 391. 1995 ≡ *Emericella omanensis* Y. Horie & Udagawa, Mycoscience 36: 391. 1995. [MB414655]. — Herb.: CBM FA-700. Ex-type: CBM FA-700. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = AB524047; *RPB2* = n.a.).
- Aspergillus oryzae*** (Ahlb.) Cohn, Jahresber. Schles. Ges. Vaterl. Cult. 61: 226. 1884 ≡ *Eurotium oryzae* Ahlb., Dingler's Polytechn. J. 230: 330. 1878. [MB184394]. — Herb.: IMI 16266. Ex-type: CBS 102.07 = NRRL 447 = ATCC 1011 = ATCC 12891 = ATCC 4814 = ATCC 7561 = ATCC 9102 = IAM13118 = IFO 4075 = IFO 537 = IFO 5375 = IMI 16266 = IMI 44242 = LSHBA c .19 = NCTC 598 = NRRL 692 = QM 6735 = Thom 113 = WB 447. ITS barcode: EF661560. (Alternative markers: *BenA* = EF661483; *CaM* = EF661506; *RPB2* = EF661438).
- Aspergillus osmophilus*** Asgari & Zare Mycoscience 55: 58. 2014. [MB803278]. — Herb.: IRAN 16110. Ex-type: IRAN 2090C = CBS 134258. ITS barcode: KC473921. (Alternative markers: *BenA* = KC474924; *CaM* = KC473918; *RPB2* = n.a.).
- Aspergillus ostianus*** Wehmer, Bot. Centralbl. 80: 461. 1899. [MB179393]. — Herb.: IMI 15960. Ex-type: CBS 103.07 = CBS 548.65 = IBT 13386 = NRRL 420 = ATCC 16887 = IMI 015960iii = IMI 15960 = LCP 89.2584 = LSHBA c .35 = NCTC 3788 = QM 7460 = Thom 4724.35 = WB 420. ITS barcode: EF661421. (Alternative markers: *BenA* = EF661324; *CaM* = EF661385; *RPB2* = EF661304).
- Aspergillus otanii*** Takada, Y. Horie & Abliz, Mycoscience 42: 364. 2001 ≡ *Neosartorya otanii* Takada, Y. Horie & Abliz, Mycoscience 42: 364. 2001. [MB474714]. — Herb.: CBM FA-914. Ex-type: NRRL 32571 (representative strain). ITS barcode: EF669961. (Alternative markers: *BenA* = EF669818; *CaM* = EF669888; *RPB2* = EF669749).
- Aspergillus pachycristatus*** Matsuzawa, Y. Horie & Yaguchi, Mycoscience 53: 439. 2012. ≡ *Emericella pachycristata* Matsuzawa, Y. Horie & Yaguchi, Mycoscience 53: 439. 2012. [MB580944]. — Herb.: IFM 55265. Ex-type: IFM 55265 = NBRC 104790. ITS barcode: n.a. (Alternative markers: *BenA* = AB375875; *CaM* = AB524062; *RPB2* = n.a.).
- Aspergillus pallidofulvus*** Visagie, Varga, Frisvad & Samson, Stud. Mycol. 78: 40. 2014. [MB809199]. — Herb.: CBS H-21796. Ex-type: CBS 640.78 = NRRL 4789 = IBT 13871 = IFO 4095 = WB 4789. ITS barcode: EF661423. (Alternative markers: *BenA* = EF661328; *CaM* = EF661389; *RPB2* = n.a.).
- Aspergillus panamensis*** Raper & Thom, Mycologia 36: 568. 1944. [MB284311]. — Herb.: IMI 19393iii. Ex-type: CBS 120.45 = NRRL 1785 = ATCC 16797 = IMI 019393ii = IMI 019393iii = IMI 19393 = LSHBA .61 = NCTC 6974 = QM 6829 = QM 8897 = WB 1785. ITS barcode: EF661177. (Alternative markers: *BenA* = EF661109; *CaM* = EF661135; *RPB2* = EF661040).
- Aspergillus papuensis*** (Samson, S.B. Hong & Varga) Samson, S.B. Hong & Varga, published here ≡ *Neosartorya papuensis* Samson, S.B. Hong & Varga, Stud. Mycol. 59: 190. 2007. [MB809593]. — Herb.: CBS H-6277. Ex-type: CBS 841.96 = IBT 27801. ITS barcode: EU220280. (Alternative markers: *BenA* = AY870738; *CaM* = AY870697; *RPB2* = n.a.).
- Aspergillus parasiticus*** Speare, Bull. Div. Pathol. Physiol., Hawaiian Sugar Planters Assoc. Exp. Sta. 12: 38. 1912. [MB191085]. — Herb.: IMI 15957ix. Ex-type: CBS 100926 = CBS 103.13 = NRRL 502 = ATCC 1018 = ATCC 6474 = ATCC 7865 = IMI 15957 = IMI 15957ii = IMI 15957iv = IMI 15957ix = IMI 15957vi = IMI 15957vii = LCP 89.2566 = LSHBA c 14 = NCTC 975 = NRRL 1731 = NRRL 3315 = NRRL A-13360 = NRRL A-14693 = Thom 3509 = WB 502. ITS barcode: AY373859. (Alternative markers: *BenA* = EF661481; *CaM* = AY017584; *RPB2* = EF661449).
- Aspergillus parvisclerotigenus*** (Mich. Saito & Tsuruta) Frisvad & Samson, Syst. Appl. Microbiol., 28: 450. 2005 ≡ *Aspergillus flavus* var. *parvisclerotigenus* Mich. Saito & Tsuruta, Proc. Jpn. Assoc. Mycotoxicol. 37: 32. 1993. [MB500166]. — Herb.: NFRI 1538. Ex-type: CBS 121.62 = IMI 093070 = NRRL A-11612. ITS barcode: EF409240. (Alternative markers: *BenA* = EF203130; *CaM* = EF202077; *RPB2* = n.a.).
- Aspergillus parvulus*** G. Sm., Trans. Brit. Mycol. Soc. 44: 45. 1961. [MB121074]. — Herb.: IMI 86558. Ex-type: CBS 136.61 = NRRL 4753 = ATCC 16911 = IMI 086558 = LSHBBB 405 = NRRL 1846 = QM 7955 = UC4613 = WB 4753. ITS barcode: EF661269. (Alternative markers: *BenA* = EF661247; *CaM* = EF661259; *RPB2* = EF661233).
- Aspergillus penicillioides*** Speg., Revista Fac. Agron. Univ. Nac. La Plata 2: 246. 1896. [MB309234]. — Herb.: IMI 211342. Ex-type: CBS 540.65 = NRRL 4548 = ATCC 16910 = IMI 211342 = IMUR540 = QM 9370 = WB 4548. ITS barcode: EF652036. (Alternative markers: *BenA* = EF651928; *CaM* = EF652024; *RPB2* = EF651930).
- Aspergillus pernambucoensis*** Y. Horie *et al.*, Mycoscience 55: 86. 2014. [MB801324]. — Herb.: IFM 61342H. Ex-type: IFM 61342 = JCM 19244. ITS barcode: n.a. (Alternative markers: *BenA* = AB743856; *CaM* = AB743862; *RPB2* = n.a.).
- Aspergillus persii*** A.M. Corte & Zotti, Mycotaxon 83: 276. 2002. [MB374215]. — Herb.: MUCL 41970. Ex-type: CBS 112795 = NRRL 35669 = IBT 22660 = MUCL 41970. ITS barcode: FJ491580. (Alternative markers: *BenA* = AY819988; *CaM* = FJ491559; *RPB2* = EF661295).
- Aspergillus peyronelii*** Sappa, Allionia 2: 248. 1955. [MB292855]. — Herb.: IMI 139271. Ex-type: CBS 122.58 = NRRL 4754 = ATCC 16840 = IMI 139271 = QM 8160 = WB 4754. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus piperis*** Samson & Frisvad, Stud. Mycol. 50: 57. 2004. [MB500009]. — Herb.: CBS H-13434. Ex-type: CBS 112811 = IBT 24630 = IBT 26239 = NRRL 62631. ITS barcode: EU821316. (Alternative markers: *BenA* = FJ629303; *CaM* = EU163267; *RPB2* = KC796427).
- Aspergillus pisci*** (A.D. Hocking & Pitt) Houbaken, Visagie & Samson, published here ≡ *Polypaecilum pisci* A.D. Hocking & Pitt [as 'pisce'] Mycotaxon 22: 200. 1985. [MB809594]. — Herb.: FRR 2732. Ex-type: FRR 2732 = ATCC 56982 = IMI 288726. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = JN121415).
- Aspergillus pluriseminatus*** (Stchigel & Guarro) Samson, Visagie & Houbaken, published here ≡ *Emericella pluriseminata* Stchigel & Guarro, Mycologia 89: 937. 1997. [MB809595]. — Herb.: FMR 5588; isotype IMI 370867. Ex-type: CBS 100523 = FMR 5588 = IMI 370867. ITS barcode: n.a. (Alternative markers: *BenA* = AY339989; *CaM* = EU443988; *RPB2* = n.a.).
- Aspergillus polyporicola*** Hubka *et al.*, Mycologia (in press). [MB808145]. — Herb.: PRM 923452. Ex-type: NRRL 32683 = CCF 4553. ITS barcode: EF669595. (Alternative markers: *BenA* = EU014088; *CaM* = EF669553; *RPB2* = EF669637).
- Aspergillus porphyreostipitatus*** Visagie, Hirooka & Samson, Stud. Mycol. 78: 112. 2014. [MB809196]. — Herb.: CBS H-21813. Ex-type: CBS 138203 = DTO 266D9. ITS barcode: KJ775564. (Alternative markers: *BenA* = KJ775080; *CaM* = KJ775338; *RPB2* = n.a.).
- Aspergillus posadasensis*** Y. Marín, Stchigel & Cano, Int. J. Syst. Evol. Microbiol. (in press). [MB803514]. — Herb.: CBS-H 21131. Ex-type: FMR 12168 = CBS 134259 = NBRC 109845. ITS barcode: HG529483. (Alternative markers: *BenA* = HG529481; *CaM* = HG529488; *RPB2* = HF954977).

- Aspergillus pragensis** Hubka, Frisvad & M. Kolařík, Med. Mycol. 52: 570. 2014. [MB800371]. — Herb.: PRM 922702. Ex-type: CCF 3962 = CBS 135591 = NRRL 62491 = IBT 32274. ITS barcode: FR727138. (Alternative markers: *BenA* = HE661604; *CaM* = FR751452; *RPB2* = n.a.).
- Aspergillus proliferans** G. Sm., Trans. Brit. Mycol. Soc. 26: 26. 1943. [MB284312]. — Herb.: IMI 16105iii. Ex-type: CBS 121.45 = NRRL 1908 = IMI 016105ii = IMI 016105iii = IMI 16105 = LSHB BB.82 = MUCL 15625 = NCTC 6546 = QM 7462 = UC 4303 = WB 1908. ITS barcode: EF652064. (Alternative markers: *BenA* = EF651891; *CaM* = EF651988; *RPB2* = EF651941).
- Aspergillus protuberus** Munt.-Cvetk., Mikrobiologia 5: 119. 1968 ≡ *Aspergillus versicolor* var. *protuberus* (Munt.-Cvetk.) Kozak., Mycol. Pap. 161: 139. 1989. [MB326650]. — Herb.: CBS 602.74. Ex-type: CBS 602.74 = NRRL 3505 = ATCC 18990 = QM 9804. ITS barcode: EF652460. (Alternative markers: *BenA* = EF652284; *CaM* = EF652372; *RPB2* = EF652196).
- Aspergillus pseudocaelatus** Varga, Samson & Frisvad, Stud. Mycol. 69: 63. 2011. [MB560397]. — Herb.: CBS H-20632. Ex-type: CBS 117616. ITS barcode: EF409242. (Alternative markers: *BenA* = EF203128; *CaM* = EF202037; *RPB2* = n.a.).
- Aspergillus pseudodeflectus** Samson & Mouch., Antonie van Leeuwenhoek 40: 345. 1975. [MB309236]. — Herb.: CBS 756.74. Ex-type: CBS 756.74 = NRRL 6135. ITS barcode: EF652507. (Alternative markers: *BenA* = EF652331; *CaM* = EF652419; *RPB2* = EF652243).
- Aspergillus pseudoelegans** Frisvad & Samson, Stud. Mycol. 50: 35. 2004. [MB500005]. — Herb.: CBS H-13439. Ex-type: CBS 112796 = NRRL 35670 = IBT 23402. ITS barcode: FJ491590. (Alternative markers: *BenA* = AY819962; *CaM* = FJ491552; *RPB2* = EF661282).
- Aspergillus pseudoglaucus** Blochwitz, Ann. Mycol. 27: 207. 1929 ≡ *Eurotium pseudoglaucum* Malloch & Cain, Can. J. Bot., 50: 64. 1972 ≡ *Eurotium repens* var. *pseudoglaucum* (Blochwitz) Kozak., Mycol. Pap. 161: 76. 1989. [MB275429]. — Herb.: IMI 016122ii. Ex-type: CBS 123.28 = NRRL 40 = ATCC 10066 = IMI 016122 = IMI 016122ii = LSHBA 19 = MUCL 15624 = QM 7463 = WB 40. ITS barcode: EF652050. (Alternative markers: *BenA* = EF651917; *CaM* = EF652007; *RPB2* = EF651952).
- Aspergillus pseudonomius** Varga, Samson & Frisvad, Stud. Mycol. 69: 67. 2011. [MB560398]. — Herb.: CBS H-20633. Ex-type: CBS 119388 = NRRL 3353 = IBT 27864. ITS barcode: AF338643. (Alternative markers: *BenA* = EF661495; *CaM* = EF661529; *RPB2* = EF661454).
- Aspergillus pseudotamarii** Yoko Ito et al., Mycol. Res. 105: 237. 2001. [MB466527]. — Herb.: BPI 746098. Ex-type: CBS 766.97 = NRRL 25517. ITS barcode: AF272574. (Alternative markers: *BenA* = EF203125; *CaM* = EF202030; *RPB2* = EU021631).
- Aspergillus pseudoterreus** S.W. Peterson, Samson & Varga, Stud. Mycol. 69: 53. 2011. [MB560396]. — Herb.: CBS H-20631. Ex-type: CBS 123890 = NRRL 4017. ITS barcode: EF669598. (Alternative markers: *BenA* = EF669523; *CaM* = EF669556; *RPB2* = EF669640).
- Aspergillus pseudoustus** Frisvad, Varga & Samson, Stud. Mycol. 69: 91. 2011. [MB560403]. — Herb.: CBS H-20637. Ex-type: CBS 123904 = NRRL 5856 = IBT 28161. ITS barcode: FJ531147. (Alternative markers: *BenA* = FJ531168; *CaM* = FJ531129; *RPB2* = n.a.).
- Aspergillus pulvericola** Visagie et al., Stud. Mycol. 78: 43. 2014. [MB809200]. — Herb.: CBS H-21793. Ex-type: CBS 137327 = DTO 267-C6. ITS barcode: KJ775440. (Alternative markers: *BenA* = KJ775055; *CaM* = KJ775236; *RPB2* = n.a.).
- Aspergillus pulverulentus** (McAlpine) Wehmer, Centralbl. Bakteriell., 2. Abth., 18: 394. 1907 ≡ *Sterigmatocystis pulverulenta* McAlpine, Agric. Gaz. N.S.W. 7: 302. 1897. [MB121243]. — Herb.: [on *Phaseolus vulgaris* from] Australia, Victoria, Burnley Bot. Garden, McAlpine (VPRI). Ex-type: CBS 558.65 = ITEM 4510. ITS barcode: EU821317. (Alternative markers: *BenA* = HE984408; *CaM* = HE984423; *RPB2* = HE984368).
- Aspergillus pulvinus** Kwon-Chung & Fennell, Gen. *Aspergillus*: 45. 1965. [MB326651]. — Herb.: IMI 139628. Ex-type: CBS 578.65 = NRRL 5078 = ATCC 16842 = IMI 139628 = QM 8937 = WB 5078. ITS barcode: EF652159. (Alternative markers: *BenA* = EF652121; *CaM* = EF652139; *RPB2* = EF652104).
- Aspergillus puniceus** Kwon-Chung & Fennell, Gen. *Aspergillus*: 547. 1965. [MB326652]. — Herb.: IMI 126692. Ex-type: CBS 495.65 = NRRL 5077 = ATCC 16800 = IMI 126692 = QM 9812 = WB 5077. ITS barcode: EF652498. (Alternative markers: *BenA* = EF652322; *CaM* = EF652410; *RPB2* = EF652234).
- Aspergillus purpureus** Samson & Mouch., Antonie van Leeuwenhoek 41: 350. 1975 ≡ *Emericella purpurea* Samson & Mouch., Antonie van Leeuwenhoek 41: 350. 1975. [MB309237]. — Herb.: CBS 754.74. Ex-type: CBS 754.74 = NRRL 6133 = IMI 334937 = LCP 82.3323. ITS barcode: EF652506. (Alternative markers: *BenA* = EF652330; *CaM* = EF652418; *RPB2* = EF652242).
- Aspergillus puulauensis** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 71. 2012. [MB800602]. — Herb.: BPI 880911. Ex-type: NRRL 35641. ITS barcode: JQ301893. (Alternative markers: *BenA* = JN853979; *CaM* = JN854034; *RPB2* = JN853823).
- Aspergillus qinqixianii** Y. Horie, Abliz & R.Y. Li, Mycoscience 41: 183. 2000 ≡ *Emericella qinqixianii* Y. Horie, Abliz & R.Y. Li, Mycoscience 41: 183. 2000. [MB464660]. — Herb.: CBM FA-866. Ex-type: no culture available. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus qizutongii** D.M. Li, Y. Horie, Yu X. Wang & R.Y. Li, Mycoscience 39: 301. 1998. [MB446576]. — Herb.: CBM FD-284. Ex-type: CBM FD-284. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus quadricinctus** E. Yuill, Trans. Brit. Mycol. Soc. 36: 57. 1953 ≡ *Sartorya quadricincta* (E. Yuill) Udagawa & H. Kaway., Trans. Mycol. Soc. Japan: 119. 1968 ≡ *Neosartorya quadricincta* (J.L. Yuill) Malloch & Cain, Can. J. Bot. 50: 2621. 1973 ≡ *Aspergillus quadricingens* Kozak., Mycol. Pap. 161: 54. 1989. [MB292857]. — Herb.: IMI 48583ii. Ex-type: CBS 135.52 = NRRL 2154 = ATCC 16897 = IMI 048583ii = IMI 48583 = QM 6874 = WB 2154. ITS barcode: EF669947. (Alternative markers: *BenA* = EF669806; *CaM* = EF669875; *RPB2* = EF669735).
- Aspergillus quadrilineatus** Thom & Raper, Mycologia 31: 660. 1939 ≡ *Emericella quadrilineata* (Thom & Raper) C.R. Benj., Mycologia 47: 680. 1955. [MB275888]. — Herb.: IMI 89351. Ex-type: CBS 591.65 = NRRL 201 = ATCC 16816 = IMI 089351ii = IMI 89351 = LSHBA .546 = QM 7465 = Thom 4138.N8 = WB 201. ITS barcode: EF652433. (Alternative markers: *BenA* = EF652257; *CaM* = EF652345; *RPB2* = EF652169).
- Aspergillus rambellii** Frisvad & Samson, Syst. Appl. Microbiol. 28: 449. 2005. [MB501209]. — Herb.: CBS 101887. Ex-type: CBS 101887 = ATCC 42001 = IBT 14580. ITS barcode: AJ874116. (Alternative markers: *BenA* = JN217228; *CaM* = n.a.; *RPB2* = JN121416).
- Aspergillus raperi** Stolk & J.A. Mey, Trans. Brit. Mycol. Soc. 40: 190. 1957. [MB292858]. — Herb.: [dried culture from soil from] Zaire, Yangambi, Meyer (K). Ex-type: CBS 123.56 = NRRL 2641 = ATCC 16917 = IFO 6416 = IMI 70949 = NRRL 4778 = NRRL A-7462 = QM 1898 = WB 4221 = WB 4778. ITS barcode: EF652454. (Alternative markers: *BenA* = EF652278; *CaM* = EF652366; *RPB2* = EF652190).
- Aspergillus recurvatus** Raper & Fennell, Gen. *Aspergillus*: 529. 1965. [MB326653]. — Herb.: IMI 36528. Ex-type: CBS 496.65 = NRRL 4902 = ATCC 16809 = IMI 136528 = O-566 = QM 7972 = WB 4902. ITS barcode: EF652482. (Alternative markers: *BenA* = EF652306; *CaM* = EF652394; *RPB2* = EF652218).
- Aspergillus restrictus** G. Sm., J. Textile Inst. 22: 115. 1931. [MB276290]. — Herb.: IMI 16267. Ex-type: CBS 117.33 = CBS 541.65 = NRRL 154 = ATCC 16912 = B35855 = CECT2075 = IHEM 3920 = IMI 16267 = LSHBBB 94 = LSHTM 93 = MUCL 31313 = NCTC 6976 = NRRL 4155 = QM 1979 = Thom 5660.93 = UC4312 = VTDD-77065 = WB 154. ITS barcode: EF652042. (Alternative markers: *BenA* = EF651880; *CaM* = EF652029; *RPB2* = EF651978).
- Aspergillus rhizopodus** J.N. Rai, Wadhvani & S.C. Agarwal, Trans. Brit. Mycol. Soc. 64: 515. 1975. [MB309240]. — Herb.: unknown. Ex-type: CBS 450.75 = IMI 385057 = WB 5442. ITS barcode: EU078652. (Alternative markers: *BenA* = EU076327; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus robustus** M. Chr. & Raper, Mycologia 70: 200. 1978. [MB309241]. — Herb.: NY WB 5286. Ex-type: CBS 428.77 = NRRL 6362 = ATCC 36106 = IMI 216610 = NRRL A-17351 = WB 5286. ITS barcode: EF661176. (Alternative markers: *BenA* = EU014101; *CaM* = EF661357; *RPB2* = EF661033).
- Aspergillus roseoglobulosus** Frisvad & Samson, Stud. Mycol. 50: 30. 2004. [MB500001]. — Herb.: CBS H-13438. Ex-type: CBS 112800 = NRRL 4565 = IBT 14720. ITS barcode: FJ491583. (Alternative markers: *BenA* = AY819984; *CaM* = FJ491555; *RPB2* = EF661299).
- Aspergillus ruber** (Jos. König et al.) Thom & Church, *Aspergillus*: 112. 1926 ≡ *Eurotium rubrum* J. König, Spieck. & W. Bremer, Z. Untersuch. Nahr. Genussm. 4: 726. 1901. [MB490579]. — Herb.: CBS 530.65. Ex-type: CBS 530.65 = NRRL 52 = ATCC 16441 = IMI 211380 = QM 1973 = Thom 5599B = WB 52. ITS barcode: EF652066. (Alternative markers: *BenA* = EF651920; *CaM* = EF652009; *RPB2* = EF651947).
- Aspergillus rugulosus** Thom & Raper, Mycologia 31: 660. 1939 ≡ *Emericella rugulosa* (Thom & Raper) C.R. Benj., Mycologia 47: 680. 1955 ≡ *Aspergillus rugulovalvus* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 49. 1985. [MB277104]. — Herb.: IMI 136775. Ex-type: CBS 133.60 = NRRL 206 = ATCC 16820 = IMI 136775 = QM 1987 = Thom 4138.T11 = WB 206.

- ITS barcode: EF652434. (Alternative markers: *BenA* = EF652258; *CaM* = EF652346; *RPB2* = EF652170).
- Aspergillus saccharolyticus*** Sørensen, Lübeck & Frisvad, Int. J. Syst. Evol. Microbiol. 61: 3081. 2011. [MB518695]. — Herb.: unknown. Ex-type: CBS 127449 = IBT 28509. ITS barcode: HM853552. (Alternative markers: *BenA* = HM853553; *CaM* = HM853554; *RPB2* = HF559235).
- Aspergillus salviicola*** Udagawa, Kamiya & Tsub., Mycoscience 35: 245. 1994. [MB362927]. — Herb.: CBM NCI 2090. Ex-type: ATCC 96334 = NCI 2090 = UAMH 8211. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus salwaensis*** Visagie *et al.*, Stud. Mycol. 78: 49. 2014. [MB809201]. — Herb.: QCC F001/14. Ex-type: CBS 138172 = DTO 297-B3. ITS barcode: KJ775447. (Alternative markers: *BenA* = KJ775056; *CaM* = KJ775244; *RPB2* = n.a.).
- Aspergillus sclerotialis*** (W. Gams & Breton) Houbraken *et al.*, published here ≡ *Sagenomella sclerotialis* W. Gams & Breton, Persoonia 10: 109. 1978 ≡ *Phialosimplex sclerotialis* (W. Gams & Breton) Sigler, Med. Mycol. 48: 341. 2010. [MB809596]. — Herb.: CBS 366.77. Ex-type: CBS 366.77 = IAM 14794. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = JN121505).
- Aspergillus scleroticarbonarius*** Noonim *et al.*, Int. J. Syst. Evol. Microbiol. 58: 1733. 2008. [MB504407]. — Herb.: unknown. Ex-type: CBS 121057 = IBT 121057. ITS barcode: EU159216. (Alternative markers: *BenA* = EU159229; *CaM* = EU159235; *RPB2* = n.a.).
- Aspergillus sclerotioniger*** Samson & Frisvad, Stud. Mycol. 50: 57. 2004. [MB500010]. — Herb.: CBS H-13433. Ex-type: CBS 115572 = IBT 22905. ITS barcode: DQ900606. (Alternative markers: *BenA* = FJ629304; *CaM* = FN594557; *RPB2* = HE984369).
- Aspergillus sclerotiorum*** G. A. Huber, Phytopathology 23: 306. 1933. [MB277707]. — Herb.: IMI 56673. Ex-type: CBS 549.65 = NRRL 415 = IBT 11931 = ATCC 16892 = DSM 870 = IFO 7542 = IMI 056732 = IMI 56673 = LCP 89.2594 = QM 6732 = Thom 5351 = WB 415. ITS barcode: EF661400. (Alternative markers: *BenA* = EF661337; *CaM* = EF661384; *RPB2* = EF661287).
- Aspergillus sepultus*** Tuthill & M. Chr., Mycologia 78: 475. 1986. [MB130306]. — Herb.: NY RMF 7602. Ex-type: CBS 257.85 = ATCC 58705 = IMI 294498. ITS barcode: FJ531074. (Alternative markers: *BenA* = FJ531023; *CaM* = FJ531101; *RPB2* = n.a.).
- Aspergillus sergii*** P. Rodrigues *et al.*, Mycologia 104: 693. 2012. [MB561842]. — Herb.: MUM-H 10.219. Ex-type: CBS 130017. ITS barcode: JF412769. (Alternative markers: *BenA* = HM803082; *CaM* = HM803029; *RPB2* = HM802985).
- Aspergillus sesamicola*** Visagie, Frisvad & Samson, Stud. Mycol. 78: 52. 2014. [MB809202]. — Herb.: CBS H-21792. Ex-type: CBS 137324 = IBT 29314 = DTO 148-B4. ITS barcode: KJ775437. (Alternative markers: *BenA* = KJ775063; *CaM* = KJ775233; *RPB2* = n.a.).
- Aspergillus shendawei*** (Yaguchi, Abliz & Y. Horie) Samson, Visagie & Houbraken, published here ≡ *Neosartorya shendawei* Yaguchi, Abliz & Y. Horie, Mycoscience 51: 260. 2010. [MB809597]. — Herb.: CBM FA-0958. Ex-type: IFM 57611. ITS barcode: n.a. (Alternative markers: *BenA* = AB488754; *CaM* = AB488762; *RPB2* = n.a.).
- Aspergillus siamensis*** Manoch & Eamvijarn, Mycoscience 54: 403. 2013. [MB561946]. — Herb.: IFM 59793. Ex-type: KUFC 6349. ITS barcode: n.a. (Alternative markers: *BenA* = AB646989; *CaM* = AB776704; *RPB2* = n.a.).
- Aspergillus silvaticus*** Fennell & Raper, Mycologia 47: 83. 1955. [MB292859]. — Herb.: IMI 61456. Ex-type: CBS 128.55 = NRRL 2398 = ATCC 16843 = ATCC 46904 = IFO 8173 = IMI 61456 = NRRL A-3107 = QM 1912 = WB 2398. ITS barcode: EF652448. (Alternative markers: *BenA* = EF652272; *CaM* = EF652360; *RPB2* = EF652184).
- Aspergillus similis*** (Y. Horie *et al.*) Samson, Visagie & Houbraken, published here ≡ *Emericella similis* Y. Horie *et al.*, Trans. Mycol. Soc. Japan 31: 425. 1990. [MB809598]. — Herb.: CBM 10007. Ex-type: CBS 293.93 = NHL 3000. ITS barcode: EU448279. (Alternative markers: *BenA* = EF428374; *CaM* = EU443987; *RPB2* = n.a.).
- Aspergillus sloanii*** Visagie, Hirooka & Samson, Stud. Mycol. 78: 108. 2014. [MB809194]. — Herb.: CBS H-21811. Ex-type: CBS 138177 = DTO 245A1. ITS barcode: KJ775540. (Alternative markers: *BenA* = KJ775074; *CaM* = KJ775309; *RPB2* = n.a.).
- Aspergillus solicola*** Samson, Visagie & Houbraken, published here ≡ *Neosartorya warcupii* Peterson, Varga & Samson, Stud. Mycol. 59: 201. 2007. [MB809599]. — Herb.: NRRL 35723. Ex-type: NRRL 35723. ITS barcode: EU220279. (Alternative markers: *BenA* = EU220283; *CaM* = EU220284; *RPB2* = n.a.).
- Aspergillus sparsus*** Raper & Thom, Mycologia 36: 572. 1944. [MB284314]. — Herb.: IMI 19394. Ex-type: CBS 139.61 = NRRL 1933 = ATCC 16851 = IHEM 4377 = IMI 19394 = IMI 19394ii = MUCL 31314 = NCTC 6975 = QM 7470 = WB 1933. ITS barcode: EF661181. (Alternative markers: *BenA* = EF661125; *CaM* = EF661173; *RPB2* = EF661071).
- Aspergillus spathulatus*** Takada & Udagawa, Mycotaxon 24: 396. 1985 ≡ *Neosartorya spathulata* Takada & Udagawa, Mycotaxon 24: 396. 1985. [MB104019]. — Herb.: NHL 2947. Ex-type: NRRL 20549 = ATCC 64222 = NHL 2948. ITS barcode: EF669943. (Alternative markers: *BenA* = EF669803; *CaM* = EF669872; *RPB2* = EF669731).
- Aspergillus spectabilis*** M. Chr. & Raper, Mycologia 70: 333. 1978 ≡ *Emericella spectabilis* M. Chr. & Raper, Mycologia 70: 333. 1978. [MB309243]. — Herb.: NY RMFH 429. Ex-type: CBS 429.77 = NRRL 6363 = ATCC 36105 = IMI 216611 = RMFH429. ITS barcode: EF652510. (Alternative markers: *BenA* = EU482437; *CaM* = EF652422; *RPB2* = EF652246).
- Aspergillus spelaeus*** A. Nováková *et al.*, Mycologia (in press). [MB808146]. — Herb.: PRM 923462. Ex-type: CCF 4425 = CMF ISB 2615 = CBS 134371 = NRRL 62826. ITS barcode: HG915905. (Alternative markers: *BenA* = HG916698; *CaM* = HG916741; *RPB2* = HG916719).
- Aspergillus spelunceus*** Raper & Fennell [as 'speluneus'], Gen. *Aspergillus*: 457. 1965. [MB326656]. — Herb.: IMI 211389. Ex-type: CBS 497.65 = NRRL 4989 = ATCC 16838 = IMI 211389 = NRRL A-3676 = QM 8898 = WB 4989. ITS barcode: EF652490. (Alternative markers: *BenA* = EF652314; *CaM* = EF652402; *RPB2* = EF652226).
- Aspergillus spinosus*** Kozak., Mycol. Pap. 161: 58. 1989 ≡ *Neosartorya spinosa* (Raper & Fennell) Kozak., Mycol. Pap. 161: 58. 1989. [MB127763]. — Herb.: IMI 211390. Ex-type: CBS 483.65 = NRRL 5034 = ATCC 16898 = IFO 8782 = IMI 211390 = NRRL A-1148 = QM 8888 = WB 5034. ITS barcode: EF669988. (Alternative markers: *BenA* = EF669844; *CaM* = EF669914; *RPB2* = EF669775).
- Aspergillus stella-maris*** Zalar, Frisvad & Samson, Mycologia 100: 789. 2008 ≡ *Emericella stella-maris* Zalar, Frisvad & Samson, Mycologia 100: 789. 2008. [MB507363]. — Herb.: CBS H-19887. Ex-type: CBS 113638 = IBT 23439. ITS barcode: EU448269. (Alternative markers: *BenA* = n.a.; *CaM* = EU443978; *RPB2* = n.a.).
- Aspergillus stellatus*** Curzi, C.R. Accad. Lincei 19: 428. 1934 = *Aspergillus stellifer* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 52. 1985 = *Aspergillus variegator* Thom & Raper, Mycologia 31: 663. 1939 = *Emericella variegator* Berk. & Broome, Intr. crypt. bot. (London): 340. 1857. [MB254841]. — Herb.: Bowenpilly near Secundarabad, s. coll., (K). Ex-type: CBS 598.65 = NRRL 1858 = ATCC 16819 = IMI 136778 = QM 6835 = WB 1858. ITS barcode: EF652426. (Alternative markers: *BenA* = EF652250; *CaM* = EF652338; *RPB2* = EF652162).
- Aspergillus steynii*** Frisvad & Samson, Stud. Mycol. 50: 39. 2004. [MB500006]. — Herb.: CBS H-13445. Ex-type: CBS 112812 = NRRL 35675 = IBT 23096. ITS barcode: EF661416. (Alternative markers: *BenA* = EF661347; *CaM* = EF661378; *RPB2* = JN121428).
- Aspergillus stramenius*** R.O. Novak & Raper, Gen. *Aspergillus*: 260. 1965 ≡ *Sartorya stramenia* (R.O. Novak & Raper) Subram., Current Science 41: 761. 1972 ≡ *Neosartorya stramenia* (R.O. Novak & Raper) Malloch & Cain, Can. J. Bot. 50: 2622. 1973 ≡ *Aspergillus paleaceus* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 50. 1985. [MB326658]. — Herb.: IMI 172293. Ex-type: CBS 498.65 = NRRL 4652 = ATCC 16895 = IFO 9611 = IMI 172293 = QM 8900 = WB 4652. ITS barcode: EF669984. (Alternative markers: *BenA* = EF669840; *CaM* = EF669910; *RPB2* = EF669771).
- Aspergillus striatus*** J.N. Rai, J.P. Tewari & Mukerji, Can. J. Bot. 42: 1521. 1964 ≡ *Emericella striata* (J.N. Rai, J.P. Tewari & Mukerji) Malloch & Cain, Can. J. Bot. 50: 62. 1972 ≡ *Aspergillus striatulus* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 50. 1985. [MB 326659]. — Herb.: IMI 96679. Ex-type: CBS 283.67 = CBS 592.65 = NRRL 4699 = ATCC 16815 = IMI 96679 = QM 8901 = WB 4699. ITS barcode: EF652470. (Alternative markers: *BenA* = EF652294; *CaM* = EF652382; *RPB2* = EF652206).
- Aspergillus stromatoides*** Raper & Fennell, Gen. *Aspergillus*: 421. 1965 ≡ *Chaetosartorya stromatoides* B.J. Wiley & E.G. Simmons, Mycologia 65: 935. 1973. [MB326660]. — Herb.: IMI 123750. Ex-type: CBS 500.65 = NRRL 4519 = ATCC 16854 = ATCC 24485 = IMI 123750 = QM 8959 = QM 8974 = WB 4519. ITS barcode: EF652146. (Alternative markers: *BenA* = EF652122; *CaM* = EF652127; *RPB2* = EF652098).
- Aspergillus subalbidus*** Visagie, Hirooka & Samson, Stud. Mycol. 78: 101. 2014. [MB809190]. — Herb.: CBS H-21807. Ex-type: CBS 567.65 = ATCC 16871 = IMI 230752 = NRRL 312. ITS barcode: KJ866983. (Alternative markers: *BenA* = EU076295; *CaM* = EF669551; *RPB2* = n.a.).
- Aspergillus sublatus*** Y. Horie, Trans. Mycol. Soc. Japan 20: 481. 1979 ≡ *Emericella sublata* Y. Horie, Trans. Mycol. Soc. Japan 20: 481. 1979.

- [MB118407]. — Herb.: IFM 4553. Ex-type: IFO 30906 = IMI 334870 = NBRC 30906 = IFM 4553. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus sublevisporus*** Someya, Yaguchi & Udagawa, Mycoscience 40: 405. 1999. \equiv *Neosartorya sublevispora* Someya, Yaguchi & Udagawa, Mycoscience 40: 405. 1999. [MB459822]. — Herb.: CBM PF-1207. Ex-type: CBS 128796 = IFM 53598. ITS barcode: AB488776. (Alternative markers: *BenA* = AB488759; *CaM* = AB488767; *RPB2* = n.a.).
- Aspergillus subolivaceus*** Raper & Fennell, Gen. *Aspergillus*: 385. 1965. [MB326661]. — Herb.: IMI 44882. Ex-type: CBS 501.65 = NRRL 4998 = ATCC 16862 = IMI 44882 = NRRL 20625 = QM 8902 = WB 4998. ITS barcode: AF257795. (Alternative markers: *BenA* = EF203144; *CaM* = EF202064; *RPB2* = n.a.).
- Aspergillus subramaninii*** Visagie, Frisvad & Samson, Stud. Mycol. 78: 55. 2014. [MB809203]. — Herb.: CBS H-21791. Ex-type: CBS 138230 = NRRL 6161 = ATCC 18413. ITS barcode: EF661403. (Alternative markers: *BenA* = EF661339; *CaM* = EF661397; *RPB2* = EF661289).
- Aspergillus subsessilis*** Raper & Fennell, Gen. *Aspergillus*: 530. 1965. [MB119551]. — Herb.: IMI 135820. Ex-type: CBS 502.65 = NRRL 4905 = ATCC 16808 = IMI 135820 = O-325 = QM 8035 = WB 4905. ITS barcode: EF652485. (Alternative markers: *BenA* = EF652309; *CaM* = EF652397; *RPB2* = EF652221).
- Aspergillus subversicolor*** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 72. 2012. [MB800603]. — Herb.: BPI 880918. Ex-type: NRRL 58999. ITS barcode: JQ301894. (Alternative markers: *BenA* = JN853970; *CaM* = JN854010; *RPB2* = JN853799).
- Aspergillus sydowii*** (Bainier & Sartory) Thom & Church, Aspergilli: 147. 1926 \equiv *Sterigmatocystis sydowii* Bainier & Sartory, Ann. Mycol. 11: 25. 1913. [MB279636]. — Herb.: IMI 211384. Ex-type: CBS 593.65 = NRRL 250 = IMI 211384 = NRRL 254. ITS barcode: EF652450. (Alternative markers: *BenA* = EF652274; *CaM* = EF652362; *RPB2* = EF652186).
- Aspergillus tabacinus*** Nakaz. et al., J. agric. Chem. Soc. Japan 10: 177. 1934 [MB539544]. — Herb.: unknown. Ex-type: CBS 122718 = NRRL 4791 = IFO 4098 = QM 9766 = WB 4791. ITS barcode: EF652478. (Alternative markers: *BenA* = EF652302; *CaM* = EF652390; *RPB2* = EF652214).
- Aspergillus taichungensis*** Yaguchi, Someya & Udagawa, Mycoscience 36: 421. 1995. [MB434473]. — Herb.: CBM PF-1167. Ex-type: IBT 19404. ITS barcode: EU076301. (Alternative markers: *BenA* = EU076297; *CaM* = EU076310; *RPB2* = n.a.).
- Aspergillus takakii*** Y. Horie, Abliz & K. Fukush., Mycoscience 103: 91. 1999 \equiv *Neosartorya takakii* Y. Horie, Abliz & K. Fukush., Mycoscience 103: 91. 1999. [MB467818]. — Herb.: CBM FA-884. Ex-type: CBM FA-884. ITS barcode: n.a. (Alternative markers: *BenA* = AB787221; *CaM* = AB787566; *RPB2* = n.a.).
- Aspergillus tamarii*** Kita, Centr. bl. Bakteri. 2. Abth. 37: 433. 1913. [MB191425]. — Herb.: CBS 104.13. Ex-type: CBS 104.13 = NRRL 20818 = QM 9374. ITS barcode: AF004929. (Alternative markers: *BenA* = EF661474; *CaM* = EF661526; *RPB2* = EU021629).
- Aspergillus tanneri*** Kwon-Chung, Sugui & S.W. Peterson, J. Clin. Microbiol. 50: 3312. 2012. [MB801149]. — Herb.: BPI 882529. Ex-type: NRRL 62426 = NIH 1005. ITS barcode: JN853798. (Alternative markers: *BenA* = JN896582; *CaM* = JN896583; *RPB2* = JN896585).
- Aspergillus tardus*** Bissett & Widden, Can. J. Bot. 62: 2521. 1984. [MB105071]. — Herb.: DAOM 183872. Ex-type: CBS 433.93 = DAOM 175187 (representative strain). ITS barcode: FJ531045. (Alternative markers: *BenA* = FJ531001; *CaM* = FJ531084; *RPB2* = n.a.).
- Aspergillus templicola*** Visagie, Hirooka & Samson, Stud. Mycol. 78: 103. 2014. [MB809191]. — Herb.: CBS H-21808. Ex-type: CBS 138181 = DTO 270C6. ITS barcode: KJ775545. (Alternative markers: *BenA* = KJ775092; *CaM* = KJ775394; *RPB2* = n.a.).
- Aspergillus tennesseensis*** Jurjevic, S.W. Peterson & B.W. Horn, IMA Fungus 3: 73. 2012. [MB800604]. — Herb.: BPI 880917. Ex-type: NRRL 13150. ITS barcode: JQ301895. (Alternative markers: *BenA* = JN853976; *CaM* = JN854017; *RPB2* = JN853806).
- Aspergillus terreus*** Thom, Am. J. Bot. 5: 85. 1918. [MB191719]. — Herb.: IMI 17294. Ex-type: CBS 601.65 = NRRL 255 = ATCC 10071 = ATCC 1012 = IFO 33026 = IMI 017294ii = IMI 17294 = JCM 10257 = LSHBA c.24 = MUCL 38640 = NCTC 981 = NRRL 543 = QM 1 = QM 1991 = Thom 144 = VKMF-67 = WB 255. ITS barcode: EF669586. (Alternative markers: *BenA* = EF669519; *CaM* = EF669544; *RPB2* = EF669628).
- Aspergillus thermomutatus*** (Paden) S.W. Peterson, Mycol. Res. 96: 549. 1992 \equiv *Aspergillus fischeri* var. *thermomutatus* Paden, Mycopathol. Mycol. Appl. 36: 161. 1968 \equiv *Neosartorya pseudofischeri* S.W. Peterson, Mycol. Res. 96: 549. 1992. [MB358403]. — Herb.: BPI 1108305. Ex-type: CBS 208.92 = NRRL 20748. ITS barcode: EF669946. (Alternative markers: *BenA* = EF669805; *CaM* = EF669874; *RPB2* = EF669734).
- Aspergillus thesauricus*** Hubka & A. Nováková, Int. J. Syst. Evol. Microbiol. 62: 2784. 2012. [MB564187]. — Herb.: PRM 860609. Ex-type: NRRL 62487 = CCF 4166 = CMFISB 2155. ITS barcode: HE615088. (Alternative markers: *BenA* = HE615095; *CaM* = HE615120; *RPB2* = HE615126).
- Aspergillus togoensis*** (Henn.) Samson & Seifert, Adv. *Penicillium Aspergillus* Syst.: 419. 1985 \equiv *Stilbothamnium togoense* Henn., Bot. Jahrb. Syst. 23: 542. 1897. [MB114720]. — Herb.: BR B 1009. Ex-type: CBS 205.75 = NRRL 13551 = LCP 67.3456 (CBS 272.89 (representative strain)). ITS barcode: AJ874113. (Alternative markers: *BenA* = FJ491477; *CaM* = FJ491489; *RPB2* = JN121479).
- Aspergillus tonophilus*** Ohtsuki, Bot. Mag. (Tokyo) 75: 438. 1962 \equiv *Eurotium tonophilum* Ohtsuki, Bot. Mag., Tokyo 75: 438. 1962. [MB326663]. — Herb.: IMI 108299. Ex-type: CBS 405.65 = NRRL 5124 = ATCC 16440 = ATCC 36504 = IMI 108299 = QM 8599 = WB 5124. ITS barcode: EF652081. (Alternative markers: *BenA* = EF651919; *CaM* = EF652000; *RPB2* = EF651969).
- Aspergillus transmontanensis*** P. Rodrigues et al., Mycologia 104: 694. 2012. [MB561843]. — Herb.: MUM-H 10.214. Ex-type: CBS 130015. ITS barcode: JF412774. (Alternative markers: *BenA* = HM803101; *CaM* = HM803020; *RPB2* = HM802980).
- Aspergillus trinidadensis*** Jurjevic, G. Perrone & S.W. Peterson, IMA Fungus 3: 170. 2012. [MB802364]. — Herb.: BPI 883908. Ex-type: NRRL 62479 = ITEM 14821. ITS barcode: n.a. (Alternative markers: *BenA* = HE984420; *CaM* = HE984434; *RPB2* = HE984379).
- Aspergillus tritici*** B.S. Mehrotra & M. Basu [as 'triticus'], Nova Hedwigia 27: 599. 1976. [MB309248]. — Herb.: unknown. Ex-type: CBS 266.81. ITS barcode: EU076302. (Alternative markers: *BenA* = EU076293; *CaM* = EU076305; *RPB2* = n.a.).
- Aspergillus tsunodae*** (Yaguchi, Abliz & Y. Horie) Samson, Visagie & Houbraken, published here \equiv *Neosartorya tsunodae* Yaguchi, Abliz & Y. Horie, Mycoscience 51: 261. 2010. [MB809600]. — Herb.: CBM FA-0950. Ex-type: IFM 57609 = NBRC 106416. ITS barcode: HE974447. (Alternative markers: *BenA* = AB488755; *CaM* = AB488763; *RPB2* = HE974400).
- Aspergillus tsurutae*** Y. Horie, Mycoscience 44: 399. 2003 \equiv *Neosartorya tsurutae* Y. Horie, Mycoscience 44: 399. 2003. [MB489534]. — Herb.: CBM FA-933. Ex-type: CBM FA-0933. ITS barcode: n.a. (Alternative markers: *BenA* = AB488760; *CaM* = AB488768; *RPB2* = n.a.).
- Aspergillus tubingensis*** Mosseray, La Cellule 43: 245. 1934. [MB255209]. — Herb.: unknown. Ex-type: NRRL 4875 = QM 8904 = WB 4875. ITS barcode: EF661193. (Alternative markers: *BenA* = EF661086; *CaM* = EF661151; *RPB2* = EF661055).
- Aspergillus turcosus*** S.B. Hong, Frisvad & Samson, Antonie van Leeuwenhoek 93: 97. 2008. [MB506378]. — Herb.: KACC 42091. Ex-type: KACC 42091. ITS barcode: n.a. (Alternative markers: *BenA* = DQ534143; *CaM* = DQ534148; *RPB2* = HF545310).
- Aspergillus turkensis*** Varga, Frisvad & Samson, Stud. Mycol. 69: 91. 2011. [MB560404]. — Herb.: CBS H-20638. Ex-type: CBS 504.65 = NRRL A-3261 = NRRL 4993 = ATCC 16799 = IMI 135420. ITS barcode: FJ531160. (Alternative markers: *BenA* = FJ531191; *CaM* = FJ531145; *RPB2* = EF652230).
- Aspergillus udagawae*** Y. Horie, Miyaji & Nishim., Mycoscience 36: 199. 1995 \equiv *Neosartorya udagawae* Y. Horie, Miyaji & Nishim., Mycoscience 36: 199. 1995. [MB412533]. — Herb.: CBM FA-0702. Ex-type: CBS 114217 = CBM FA-0702. ITS barcode: AB250781. (Alternative markers: *BenA* = AF132226; *CaM* = AB748566; *RPB2* = n.a.).
- Aspergillus undulatus*** H.Z. Kong & Z.T. Qi, Acta Mycol. Sin. 4: 211. 1985 \equiv *Emicella undulata* H.Z. Kong & Z.T. Qi, Acta Mycol. Sin. 5: 211. 1986. [MB129004]. — Herb.: HMAS 47644. Ex-type: CBS 261.88. ITS barcode: EU448275. (Alternative markers: *BenA* = EF428363; *CaM* = EU443989; *RPB2* = n.a.).
- Aspergillus unguis*** (Émile-Weill & L. Gaudin) Thom & Raper, Mycologia 31: 667. 1939 \equiv *Sterigmatocystis unguis* Émile-Weill & L. Gaudin, Arch. Med. Exp. Anat. Pathol. 28: 463. 1918 \equiv *Emicella unguis* Malloch & Cain, Can. J. Bot. 50: 62. 1972. [MB255264]. — Herb.: IMI 136526. Ex-type: CBS 132.55 = NRRL 2393 = ATCC 16812 = IMI 136526 = NRRL A-2391 = NRRL A-445 = QM 25B = WB 2393. ITS barcode: EF652443. (Alternative markers: *BenA* = EF652267; *CaM* = EF652355; *RPB2* = EF652179).
- Aspergillus unilateralis*** Thrower, Aust. J. Bot. 2: 355. 1954 \equiv *Aspergillus brevipes* var. *unilateralis* (Thrower) Kozak., Mycol. Pap. 161: 54. 1989. [MB292862]. — Herb.: IMI 62876. Ex-type: CBS 126.56 = NRRL 577 = ATCC 16902 = IFO 8136 = IMI 062876 = QM 8163 = WB 4366 = WB 4779. ITS barcode: EF669997. (Alternative markers: *BenA* = EF669852; *CaM* = EF669923; *RPB2* = EF669784).

- Aspergillus ustus*** (Bainier) Thom & Church, *Aspergilli*: 152. 1926 ≡ *Sterigmatocystis usta* Bainier, *Bull. Soc. Bot. Fr.* 28: 78. 1881. [MB281216]. — Herb.: IMI 211805. Ex-type: CBS 261.67 = NRRL 275 = ATCC 1041 = ATCC 16818 = IMI 211805 = QM 7477 = WB 275. ITS barcode: EF652455. (Alternative markers: *BenA* = EF652279; *CaM* = EF652367; *RPB2* = EF652191).
- Aspergillus uvarum*** G. Perrone, Varga & Kozak., *Int. J. Syst. Evol. Microbiol.* 58: 1036. 2008. [MB510962]. — Herb.: IMI 388523. Ex-type: CBS 121591 = IBT 26606 = IMI 388523 = ITEM 4834. ITS barcode: AM745757. (Alternative markers: *BenA* = AM745751; *CaM* = AM745755; *RPB2* = HE984370).
- Aspergillus vadensis*** R.P. de Vries, Frisvad & Visser, *Antonie van Leeuwenhoek* 87: 201. 2005. [MB340234]. — Herb.: CBS 113365. Ex-type: CBS 113365 = CECT20584 = IMI 313493. ITS barcode: AY585549. (Alternative markers: *BenA* = AY585531; *CaM* = FN594560; *RPB2* = HE984371).
- Aspergillus varians*** Wehmer, *Bot. Centralbl.* 80: 460. 1899. [MB172782]. — Herb.: IMI 172297. Ex-type: CBS 505.65 = NRRL 4793 = ATCC 16836 = IFO 4114 = IMI 172297 = WB 4793. ITS barcode: EF652479. (Alternative markers: *BenA* = EF652303; *CaM* = EF652391; *RPB2* = EF652215).
- Aspergillus venenatus*** Jurjevic, S.W. Peterson & B.W. Horn, *IMA Fungus* 3: 73. 2012. [MB800605]. — Herb.: BPI 880916. Ex-type: NRRL 13147. ITS barcode: JQ301896. (Alternative markers: *BenA* = JN854003; *CaM* = JN854014; *RPB2* = JN853803).
- Aspergillus venezuelensis*** Frisvad & Samson, *Syst. Appl. Microbiol.* 27: 678. 2004 ≡ *Emericella venezuelensis* Frisvad & Samson, *Syst. Appl. Microbiol.* 27: 678. 2004. [MB368544]. — Herb.: CBS 868.97. Ex-type: CBS 868.97 = IBT 20956. ITS barcode: AJ874119. (Alternative markers: *BenA* = AY339998; *CaM* = EU443977; *RPB2* = n.a.).
- Aspergillus versicolor*** (Vuill.) Tirab., *Ann. Bot. (Roma)* 7: 9. 1908 ≡ *Sterigmatocystis versicolor* Vuill., *Erreur Dét. Asp. Paras. Homme*: 15. 1903. [MB172159]. — Herb.: CBS 538.65. Ex-type: CBS 538.65 = NRRL 238 = ATCC 9577 = IFO 33027 = IMI 229970 = JCM 10258 = QM 7478 = Thom 5519.57 = WB 238. ITS barcode: EF652442. (Alternative markers: *BenA* = EF652266; *CaM* = EF652354; *RPB2* = EF652178).
- Aspergillus vinosobubalinus*** Udagawa, Kamiya & Kaori Osada, *Trans. Mycol. Soc. Japan* 34: 255. 1993. [MB361186]. — Herb.: CBM BF-33501. Ex-type: CBM BF-33501. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus violaceus*** Fennell & Raper, *Mycologia* 47: 75. 1955 ≡ *Emericella violacea* (Fennell & Raper) Malloch & Cain, *Can. J. Bot.* 50: 62. 1972 ≡ *Aspergillus violaceobrunneus* Samson & W. Gams, *Adv. Penicillium Aspergillus Syst.*: 53. 1985. [MB292863]. — Herb.: IMI 61449. Ex-type: CBS 138.55 = NRRL 2240 = ATCC 16813 = CECT2587 = IFO 8106 = IMI 061449ii = IMI 61449 = LCP 82.3318 = NRRL A-3156 = QM 1905 = UC4511 = WB 2240. ITS barcode: EF652438. (Alternative markers: *BenA* = EF652262; *CaM* = EF652350; *RPB2* = EF652174).
- Aspergillus viridinutans*** Ducker & Thrower, *Aust. J. Bot.* 2: 355. 1954. [MB292864]. — Herb.: IMI 62875. Ex-type: CBS 127.56 = NRRL 4365 = NRRL 4782 = NRRL 576 = NRRL A-16083 = NRRL A-6281 = ATCC 16901 = IMI 367415 = IMI 62875 = WB 4081 = WB 4365 = WB 4782. ITS barcode: EF669978. (Alternative markers: *BenA* = AF134779; *CaM* = DQ534162; *RPB2* = EF669765).
- Aspergillus vitricola*** Ohtsuki, *Bot. Mag. (Tokyo)* 75: 436. 1962. [MB326665]. — Herb.: unknown. Ex-type: NRRL 5125 = ATCC 16905 = ATCC 36505 = IMI 108298 = WB 5125. ITS barcode: EF652046. (Alternative markers: *BenA* = EF651927; *CaM* = EF652035; *RPB2* = EF651973).
- Aspergillus waksmanii*** Hubka *et al.*, *Int. J. Syst. Evol. Microbiol.* 63: 786. 2013. [MB801063]. — Herb.: PRM 860537. Ex-type: NRRL 179 = CCF 4266 = Thom 4138.H52 = IBT 31900. ITS barcode: EF669934. (Alternative markers: *BenA* = EF669794; *CaM* = EF669863; *RPB2* = EF669722).
- Aspergillus wangduanlii*** D.M. Li *et al.*, *Mycoscience* 39: 302. 1998. [MB447107]. — Herb.: CBM FD-283. Ex-type: CBM FD-283 = CMMB 2309. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.).
- Aspergillus welwitschiae*** (Bres.) Henn. *apud* Wehmer, *Centrbl. Bakteriol. Parasitk.* 2 18: 294. 1907 ≡ *Ustilago welwitschiae* Bres., *Bol. Soc. Brot.* 11: 68. 1893 ≡ *Sterigmatocystis welwitschiae* (Bres.) Henn., *Kunene-Sambesi Expedit.*: 168. 1903. [MB490584]. — Herb.: CBS 139.54. Ex-type: CBS 139.54. ITS barcode: FJ629340. (Alternative markers: *BenA* = FJ629291; *CaM* = KC480196; *RPB2* = n.a.).
- Aspergillus wentii*** Wehmer, *Centralbl. Bakteriol.*, 2. Abth., 2: 149. 1896. [MB172623]. — Herb.: IMI 17295. Ex-type: CBS 104.07 = NRRL 375 = ATCC 1023 = IMI 17295 = NCTC 597 = NRRL 1269 = QM 7479 = Thom 116 = WB 375. ITS barcode: EF652151. (Alternative markers: *BenA* = EF652106; *CaM* = EF652131; *RPB2* = EF652092).
- Aspergillus westerdijkiae*** Frisvad & Samson, *Stud. Mycol.* 50: 30. 2004. [MB500000]. — Herb.: CBS H-13444. Ex-type: CBS 112803 = NRRL 3174 = IBT 10738 = ATCC 22947 = IBT 10738 = MUCL 39539. ITS barcode: EF661427. (Alternative markers: *BenA* = EF661329; *CaM* = EF661360; *RPB2* = EF661307).
- Aspergillus westlandensis*** Visagie *et al.*, *Stud. Mycol.* 78: 59. 2014. [MB809204]. — Herb.: CBS H-21795. Ex-type: CBS 137321 = IBT 32139 = DTO 231-A9. ITS barcode: KJ775434. (Alternative markers: *BenA* = KJ775066; *CaM* = KJ775230; *RPB2* = n.a.).
- Aspergillus wyomingensis*** A. Nováková, Dudová & Hubka, *Fungal Divers.* 64: 270. 2014. [MB803936]. — Herb.: PRM 861504. Ex-type: CCF 4417 = CMF ISB 2494. ITS barcode: HG324081. (Alternative markers: *BenA* = HF933359; *CaM* = HF933397; *RPB2* = HF937378).
- Aspergillus xerophilus*** Samson & Mouch., *Antonie van Leeuwenhoek* 41: 348. 1975 ≡ *Eurotium xerophilum* Samson & Mouch., *Antonie van Leeuwenhoek* 41: 348. 1975. [MB309251]. — Herb.: CBS 938.73. Ex-type: CBS 938.73 = NRRL 6131. ITS barcode: EF652085. (Alternative markers: *BenA* = EF651923; *CaM* = EF651983; *RPB2* = EF651970).

Excluded and doubtful species

- Aspergillus amazonensis* (Henn.) Samson & Seifert, *Adv. Penicillium Aspergillus Syst.*: 418. 1985 ≡ *Stilbothamnium amazonense* Henn., *Hedwigia* 43: 396. 1904. [MB114696]. — Herb.: Brazil, Jurna, Jul 1907, Ule in herb. Hennings (S). Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Apart from herbarium material, there is no ex-type culture or sequences available. As such, we cannot confirm the taxonomic position of the species.
- Aspergillus clavatoflavus* Raper & Fennell, *Gen. Aspergillus*: 378. 1965. [MB326619]. — Herb.: IMI 124937. Ex-type: CBS 473.65 = NRRL 5113 = ATCC 16866 = IMI 124937 = QM 8877 = WB 5113. Note: Molecular data suggest that this species does not belong to *Aspergillus* (Peterson 2008, Houbraken & Samson 2011).
- Aspergillus collembolorum* Dörfelt & A.R. Schmidt, *Mycol. Res.* 109: 956. 2005. [MB344420]. — Herb.: Hoffeins 805. Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Apart from herbarium material, there is no ex-type culture or sequences available. As such, we cannot confirm the taxonomic position of the species.
- Aspergillus curviformis* H.J. Chowdhery & J.N. Rai, *Nova Hedwigia* 32: 231. 1980. [MB118396]. — Herb.: [dried culture from soil from] India, Kagh Islands, s.coll. (LWG). Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Apart from the location of the herbarium specimen, there is no information available with regards to ex-type cultures or sequences. As such, we cannot confirm the taxonomic position of the species.
- Aspergillus dybowskii* (Pat.) Samson & Seifert, *Adv. Penicillium Aspergillus Syst.*: 422. 1985 ≡ *Penicillioptosis dybowskii* Pat., *Bull. Soc. Mycol. Fr.* 8: 54. 1892. [MB114702]. — Herb.: Congo, Jan 1894, Dybowski in herb. Bresadola (S). Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Apart from herbarium material, there is no ex-type culture or sequences available. As such, we cannot confirm the taxonomic position of the species.
- Aspergillus erythrocephalus* Berk. & M.A. Curtis, *J. Linn. Soc. Bot.* 10: 362. 1868. [MB212597]. — Herb.: Cuba, Wright 764 (K). Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Apart from herbarium material, there is no ex-type culture or sequences available. As such, we cannot confirm the taxonomic position of the species.
- Aspergillus globosus* H.J. Chowdhery & J.N. Rai, *Nova Hedwigia* 32: 233. 1980 (*nom. illegit.*, Art. 53.3). [MB118398]. — Herb.: [dried culture from soil from] India, Kagh Islands, s.coll. (LWG). Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: *Aspergillus globosus* Link is the older name for the epithet and thus makes this an illegitimate name under Art. 53.3. Apart from the designation of a herbarium specimen, there is no information available with regards to ex-type cultures or sequences. As such, we cannot confirm the taxonomic position of the species.
- Aspergillus ornatus* Samson & W. Gams, *Adv. Penicillium Aspergillus Syst.*: 45. 1985 ≡ *Sclerocleista ornata* (Raper, Fennell & Tresner) Subram., *Current Science* 41: 757. 1972. [MB114712]. — Herb.: IMI 55295. Ex-type: CBS

124.53 = NRRL 2256 = ATCC 16921 = IMI 55295 = LSHBBB .311 = MUCL 15643 = NRRL A-3471 = QM 1951 = UC4518 = WB 2256. Note: Molecular data suggest that this species belongs to a clade distinct from *Aspergillus* (Houbraken & Samson 2011).

Aspergillus spinulosus Warcup, Gen. *Aspergillus*: 204. 1965 = *Raperia spinulosa* (Warcup) Subram. & Rajendran, Kavaka 3: 133. 1976 = *Warcupia spinulosa* (Warcup) Subram., Curr. Sci. 41: 757. 1972 = *Aspergillus warcupii* Samson & W. Gams, Adv. *Penicillium Aspergillus* Syst.: 50. 1985. [MB326657]. — Herb.: IMI 75885. Ex-type: CBS 512.65 = NRRL 4376 = A41/4 = ATCC 16919 = IFO 31800 = IMI 238611 = IMI 75885 = IMI 75885ii = IMI 75885iii = IMI 75885iv = QM 7858 = WB 4376. ITS barcode: EF669706. (Alternative markers: *BenA* = EF669680; *CaM* = EF669698; *RPB2* = EF669666). Note: Molecular data showed that this species belongs in a phylogenetic clade with *Hamigera*.

Aspergillus taklimakanensis Abliz & Y. Horie, Mycoscience 42: 289. 2001 = *Eurotium taklimakanense* Abliz & Y. Horie, Mycoscience 42: 289. 2001. [MB474683]. — Herb.: CBM FA-876. Ex-type: CBM FA-876 = Y. Horie No. 98-TA-571-C. Note: The ex-type culture no longer exist. As such we cannot confirm its taxonomic position and consider it a doubtful species.

Aspergillus vitellinus (Massee) Samson & Seifert, Adv. *Penicillium Aspergillus* Syst.: 417. 1985 = *Sterigmatocystis vitellina* Ridl. ex Massee, J. Bot. 34: 152. 1896. [MB114721]. — Herb.: Singapore, 1894, Ridley 2970 (K). Ex-type: unknown. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: Apart from herbarium material, there is no ex-type culture or sequences available. As such, we cannot confirm the taxonomic position of the species.

Aspergillus zonatus Kwon-Chung & Fennell, Raper & Fennell, Gen. *Aspergillus*: 377. 1965. [MB326666]. — Herb.: CBS 506.65. Ex-type: CBS 506.65 = NRRL 5079 = ATCC 16867 = IFO 8817 = IMI 124936 = NRRL 25543 = QM 8919 = WB 5079. ITS barcode: EF669712. (Alternative markers: *BenA* = EF669679; *RPB2* = EF669665; *CaM* = EF669701). Note: Molecular data suggest that this species does not belong to *Aspergillus* (Peterson 2008, Houbraken & Samson 2011).

Dactylomyces thermophilus Sopp, Skr. Vidensk.-Selsk. Christiana Math.-Nat. Kl. 11: 35. 1912 = *Penicillium thermophilum* (Sopp) Sacc., Sylloge Fungorum 25: 671. 1931 = *Thermoascus thermophilus* (Sopp) Arx, The genera of fungi sporulating in pure culture: 94. 1974. [MB224271]. — Herb.: CBS H-18805. Ex-type: CBS 528.71 = BDUN 394 = IMI 123298 = NRRL 5208 = ATCC 26413. Note: Non *Talaromyces thermophilus* Stolk. The genus *Dactylomyces* was introduced for the ascoma producing *D. thermophilus*. This species also produces an anamorph that resembles *Polypaecilum* (Apinis 1967, Stchigel & Guarro 2007). Phylogenetically this species, however, belongs in *Thermoascus* (Houbraken & Samson 2011) and is thus unrelated to *Aspergillus*.

Eurotium amstelodami L. Mangin, Ann. Sci. Nat., Bot., sér. 9 10: 360. 1908. [MB238336]. — Herb.: unknown. Ex-type: unknown. Note: Hubka et al. (2013a,b) showed that neotypification of this species by Samson & Gams (1985) and Pitt & Samson (1993) was based on an erroneous species concept of *Eurotium amstelodami* and its anamorph name *Aspergillus amstelodami*.

Polypaecilum botryoides (F.T. Brooks & Hansf.) V. Rao & de Hoog, Persoonia 8: 202. 1975 = *Torula botryoides* F.T. Brooks & Hansf., Trans. Brit. Mycol. Soc. 8: 134. 1923 (nom. illegit., Art. 53.1). [MB320881]. — Herb.: CBS 143.23. Ex-type: CBS 143.23 = MUCL 7919. ITS barcode: n.a. (Alternative markers: *BenA* = n.a.; *CaM* = n.a.; *RPB2* = n.a.). Note: The ex type culture is available but has not been sequenced. As such, its taxonomic position is unclear and needs further studies.

Polypaecilum thermophilum Dong M. Wang & D.C. Li, J. Fungal Res. 2: 47. 2004. [MB542322]. — Herb.: HSAUP <sub>(03)>80011. Ex-type: unknown. Note: Apart from the designation of a herbarium specimen, there is no information available with regards to ex-type culture or sequences. As such, we cannot confirm the taxonomic position of the species and consider it doubtful.

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APPENDIX A. SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.simyco.2014.07.004>.

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